A profile of out-of-hospital cardiac arrests in Northern Emirates, United Arab Emirates

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ABSTRACT

الأهداف: دراسة خصائص ضحايا السكتات القلبية خارج المستشفى والمخرجات في إمارات الشارقة ورأس الخيمة وأم القيوين والفجيرة وعجمان.

الطريقة: هذه دراسة وصفية استباقية لمجموعة من حالات سكتات القلب خارج المستشفى والتي نقلها طواقم الإسعاف الوطني في الفترة من فبراير 2014 حتى مارس 2015.

النتائج: تناولت الدراسة 384 حالة. شكلت 76% من الحالات ذكور أصيبوا بسكتات قلبية. متوسط العمر لمجموعة البحث هو 50.9 سنة. نسبة استعادة الدورة الدموية التلقائية التي وُثقت كانت 3.1% إلى جانب توثيق نسبة 30% من الإنعاش القلبي الرئوي الذي قام به حاضرون في مكان الحدث. استُعين بأجهزة إزالة الرجفان البطيني الخارجية المتاحة للجمهور في 0.5% من الحالات وعُرضت البيانات وفق مقاييس أوتستاين للتقارير.

الخاتمة: لأول مرة تم حصر البيانات الأساسية الخاصة بحالات سكتات القلب في الإمارات التي تقع في شمال الإمارات العربية المتحدة. نسبة ضعيفة لحالات النجاة من سكتة القلب، ونسبة ضعيفة للإنعاش القلبي الرئوي الذي قام به الحاضرون في مكان الحدث واستخدام الجمهور أجهزة إزالة الرجفان البطيني. بالرغم من أن النسب تعد ضعيفة مقارنة بالبلدان الغربية إلا أن النتائج مشابهة في بلدان منطقة الشرق الأوسط. تحديد البيانات الأساسية الواردة في هذه الدراسة ضرورية للحد من الوفيات الناجمة عن السكتة القلبية خارج المستشفى.

Objectives: To report the characteristics of out-of-hospital cardiac arrest patients and their outcomes in the emirates of Sharjah, Ras-al-Khaimah, Umm Al-Quwain, Fujairah, and Ajman in the United Arab Emirates (collectively known as the Northern Emirates).

Methods: This is a prospective descriptive cohort study of out-of-hospital cardiac arrest incidents transported by the national ambulance crews between February 2014 and March 2015 in the Northern Emirates.

Results: A total of 384 patients were enrolled in this study. Male victims of out-of-hospital cardiac arrest represented 76% of the participants. The mean age of the study population was 50.9 years. An over-all prehospital return of spontaneous circulation rate of 3.1% was documented, as well as a 30% rate of bystander cardiopulmonary resuscitation being performed. Public access defibrillators were applied in 0.5% of cases. Data is presented according to Utstein reporting criteria.

Conclusion: Baseline data for out-of-hospital cardiac arrest was established for the first time in the Northern Emirates of the United Arab Emirates. A low survival rate for out-of-hospital cardiac arrest, low rates of bystander cardiopulmonary resuscitation, and low public access defibrillator use were discovered. Although low by comparison to established western systems results are similar to other systems in the region. Determining the baseline data presented in this study is essential in recommending and implementing strategies to reduce mortality from out-of-hospital cardiac arrest.

Out-of-hospital cardiac arrest (OHCA) is a major cause of mortality worldwide. Survival rates from OHCA vary drastically around the world with survival rates lower in the Middle East and Asia compared to those in the Western Europe and North America. Recent studies have demonstrated low survival rates for cardiac arrests in Saudi Arabia,[1] and the Emirates

of Dubai.[2,3] The National Ambulance (NA) LLC began Emergency Medical Service (EMS) operations in the Emirates of Al-Sharjah, Ras-al-Khaimah, Umm Al-Quwain, Al-Fujairah, and Ajman in February 2014. These 5 Emirates are collectively known as the Northern Emirates. Prior to the establishment of the NA service in the Emirates, the existing ambulance services were unevenly distributed, varied largely in their ability to provide uniform levels of care, equipment was variable, and data capture was inconsistent. The NA Northern Emirates service area is a single-tier Basic Life Support (BLS) ambulance service, which was initially staffed (during the study period) with 269 emergency medical technicians (EMTs), manning 24 ambulances based at 14 stations, and 25 standby points across the Northern Emirates area. The geographic area covers approximately 12,100 km², and contains a population of approximately 4.7 million persons. The service responded to 31,786 emergency medical calls in the same period, with a total of 33,467 patients transported to hospital. All emergency medical calls received from the NE service area are received in the Ambulance Communications Center (ACC) in Abu Dhabi. The NA ACC uses King County Criteria Based Dispatch (CBD) under licence, and has 2 on-site licensed CBD trainers. The CBD ensures that early pre-arrival information is provided to the caller. The communications center is staffed by 25 call takers and dispatchers, with support from 5 team leaders, operating 24-hours a day. A backup communications center based off-site is also located in Abu Dhabi. Members of the public ring 998 in a medical emergency, and this call is routed directly to the NA communications center. Call takers speak Arabic and other languages to aid callers. Other languages include English, Tagalog, and Spanish. The call details are then passed to a dispatcher who dispatches an ambulance to cardiac arrest all ideally within a 60-second time frame from receipt of call. Other details are then gathered from the caller. An optional 998 mobile application is also available through which registered users can request an ambulance to attend their GPS-fixed location. The UAE has an age standardized death rate for cardiovascular disease of 308.9 per 100,000 for males and 203.9 per 100,000 for females.[4] This figure includes expatriate and national populations. In the United Arab Emirates (UAE) there are approximately 2 males for every female

in the population, and the majority of the population are expatriates of working age (median age 33.3 years).[5] An estimated 15-20% of the total population of UAE are UAE nationals, with the remainder comprised of expatriate workers from all around the globe. As part of its commitment to improving the health and well-being of both UAE nationals and residents in the UAE, NA is a contributing members to the Pan-Asian Resuscitation Outcomes Study (PAROS), an international cardiac arrest registry study comprising member states across the Asia-Pacific region.[6] Through their contribution of data to the PAROS study, member states aim to share information to allow for a collaborative problem-solving approach to the issue of OHCA.

Limited data surrounding OHCA in the Gulf region has been published, with the exception of studies in Saudi Arabia and Lebanon.[1] With the exception of Dubai, no OHCA data has been published for the remaining 6 Emirates in the UAE. The aim of this study was to identify patient characteristics and outcomes of all OHCA cases presenting to NA crews in the Northern Emirates. The collation and publication of this data represents the profiling of OHCA cases in these 5 Emirates.

Methods. A prospective cohort study design was applied to the study of all presenting cases of OHCA between February 2014 and March 2015 in the NA Northern Emirates service area of the UAE.[3] A literature search was also performed. The study complies with the Declaration of Helsinki and received ethical approval from the Office of the Chief Medical Advisor, NA LLC. The implementation of the PAROS study has received various institutional review board approvals from the countries involved in the PAROS study to which NA LLC is a contributing member.

Emergency medical technicians who provided care for cardiac arrest patients completed PAROS data collection forms specifically designed for this study and approved by PAROS, which were then reviewed by the PAROS coordinator in the NA. Data requiring clarification such as dispatch and arrival times were cross-referenced with dispatch information before entry into PAROS database. All cases of OHCA treated by the EMT crews were included in this study. Cardiac arrest was defined as cessation of cardiac mechanical activity that was confirmed by the absence of a palpable pulse, unresponsiveness, and absence of spontaneous respirations at the site of arrest. The NA clinical treatment protocols (based on the 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care)

during the period of this data collection mandated the transportation of all OHCA cases to the hospital (unless obviously dead with rigor mortis, decapitation, dependant lividity, incineration, other injuries totally incompatible with life, and so forth). Do-not-resuscitate orders do not exist within the UAE. The EMTs have no ability to obtain 12-lead ECGs during the study period.

Exclusion criteria were patients who were not treated by EMTs due to recognition of death at scene. Return of spontaneous circulation (ROSC) rate only includes patients who gained ROSC on-scene, or prior to hospital arrival. Patients who had ROSC subsequent to hospital arrival were excluded from analysis for this outcome. Results from post-mortem examinations were not utilized. Utstein style[7] of reporting data is incomplete due to non-availability of hospital data.

Statistical analysis was performed using the Statistical Package for Social Sciences (IBM SPSS Version 20, NY, USA). Descriptive analysis was performed to determine distribution and frequency, independent group t-test was used to compare age and gender means, and percentages were used to describe and report variables and patient characteristics.

Results. A total of 384 OHCA patients who presented to the NA EMT crews were enrolled in this study. Based on the population in the 5 Emirates studied (estimated at 4.7 million), this equates to 8.2 OHCA resuscitation attempts per 100,000 persons during this period. The finding suggests gender variation in age of OHCA presentation. Male patients tended to be younger than the female patients (49 years versus 55 years, *p*=0.029). There were missing data for age, or date of birth for 12 of cases, these cases were excluded for analysis. Patients age ranged were <1 year to 95 years old (mean age: 50.9 years, SD ± 21.1 years, median: 53 years, interquartile range [IQR]: 35.5, 65.0) (**Figure 1**).

Males comprised of 76% (n=291). Patients enrolled in this study with known chronic illnesses represented 78.1% of the study population. Reported chronic illnesses included known history of diabetes mellitus, cardiovascular disease, renal disease, and respiratory diseases. Individuals from the Indian subcontinent represented the largest group of OHCA, accounting for 38.8% of all cases (n=149) while patients from other Arab countries represented 23.7% (n=91) of all cases. The UAE nationals accounted for 16.7% (n=64) of cases. Further patient characteristics are outlined in **Table 1**.

Of the 384 OHCA cases, over half occurred at a home residence (n=208; 54.2%). The next most common location was on a street, or highway (n=71, 18.5%). Other locations are summarized in **Table 1** and **Figure 2**.

The median response time was 9 minutes from receipt of emergency medical call to arrival of the crew at the scene (IQR: 6, 14). An ambulance arrive at scene within 14 minutes of receipt of an emergency medical
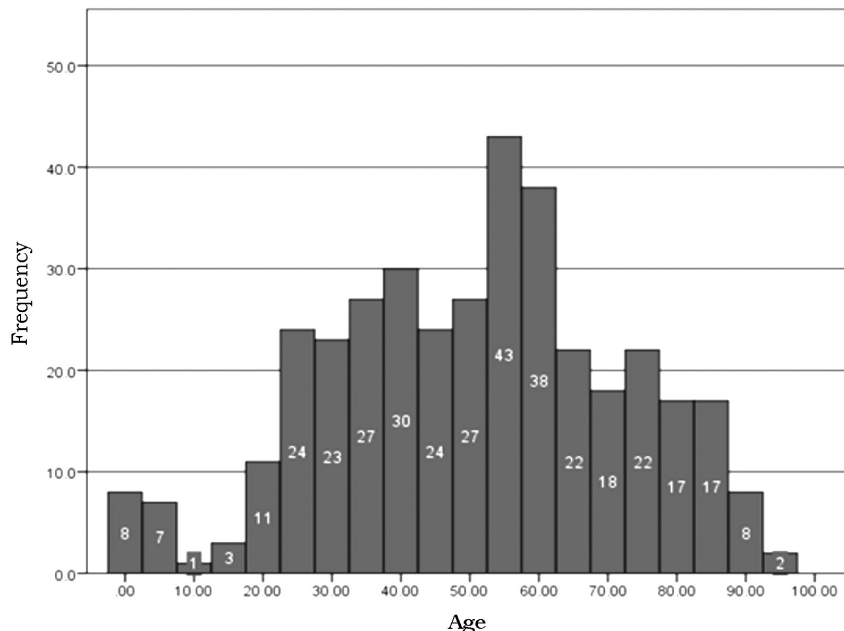
Figure 1 - Age distribution and frequency of OHCA cases in Northern Emirates, UAE between 2014 and March 2015. OHCA - Out-of-hospital cardiac arrest, UAE - United Arab Emirates

call in 75% of cardiac arrests. Time to arrival at scene data was missing for 4 cases. Almost all patients were transported to the hospital (n=382; 99.5%) by NA crews, with 2 patients pronounced dead at the scene by a physician. Data for OHCA cases presented to the to Emergency Departments (ED) by means other than NA crews is unavailable for this study period as hospital sites did not begin collecting OHCA data until March 2015.

A total of 212 incidents were witnessed by a bystander (55.2%) and 30 events were witnessed by the NA EMTs (7.8%). There were 140 incidents that were not witnessed (36.4%). Data was missing for 2 incidents. Cardiopulmonary resuscitation (CPR) advice was offered by ACC call-takers and dispatchers to all callers once a diagnosis of cardiac arrest was confirmed or suspected, utilizing King County CBD. Of this, a total of 268 (69.9%) callers acknowledged using these CPR instructions.

Bystander CPR was attempted in 30% (n=115) of cases as confirmed by NA crews on arrival at scene. A bystander automated external defibrillator (AED) was applied in only 2 cases, and no shocks were delivered in either case. Only 67 patients (17%) were in a shockable rhythm at time of first rhythm analysis. The prevalence of presenting rhythms is outlined in **Figure 3**.

Of the total 382 patients transported to ED, 370 patients were transported with no record of ROSC at any stage pre-hospital. An overall out-of-hospital (at scene, or en-route) return-of-spontaneous-circulation (ROSC) rate of 3.1% (n=12) was observed. In addition a further 2.3% ROSC rate was observed in-hospital during, or immediately after EMS hand-over. This percentage group is not included in the data analysis. Full Utstein style[7] of reporting data is shown in **Figure 4**.
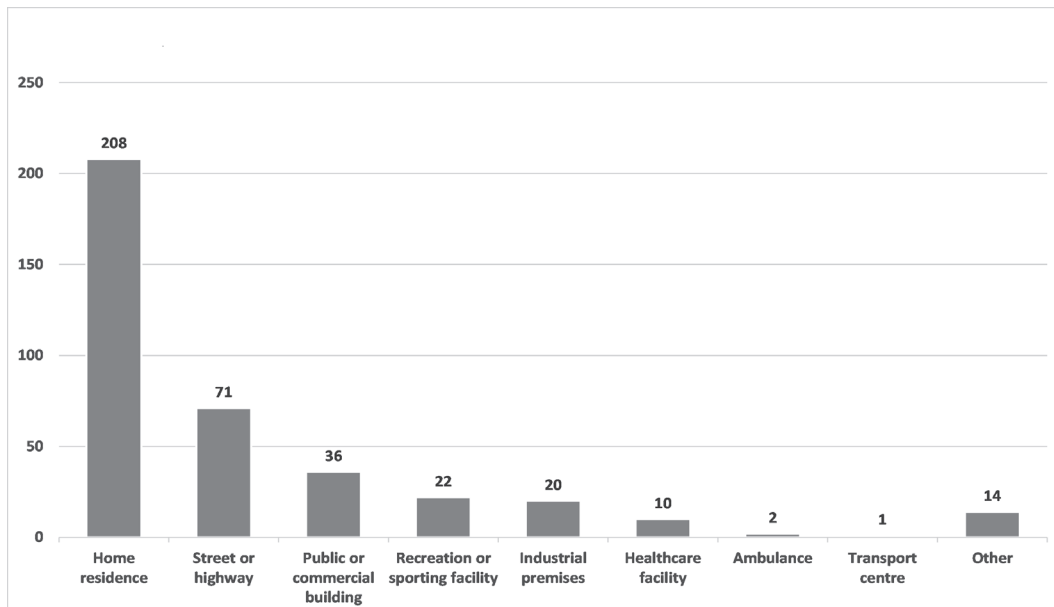
A mechanical CPR device (LUCAS-2, Physio-Control Inc., USA) was applied in 273 cases (71%) by EMTs. A supraglottic airway device was inserted in 322 cases (84%) with the most commonly used airway device being the iGel (Intersurgical Ltd., UK). A total of 181 cases had defibrillation attempted (47.1%) on a shockable rhythm at some stage, either on-scene or en-route to receiving facility. The median time to first shock from arrival of EMTs at the patient's side was 8 minutes (IQR 3,16). All patients were transported to tertiary level centers. Cardiopulmonary resuscitation quality data was not collected for the study period.

A total of 12 cases gained ROSC at some stage in the pre-hospital setting. Eight of these cases had bystander CPR performed prior to ambulance crew arrival (67%). Seven of the ROSC group were female (58%) and the mean age was 42. Seven of these cases occurred at a
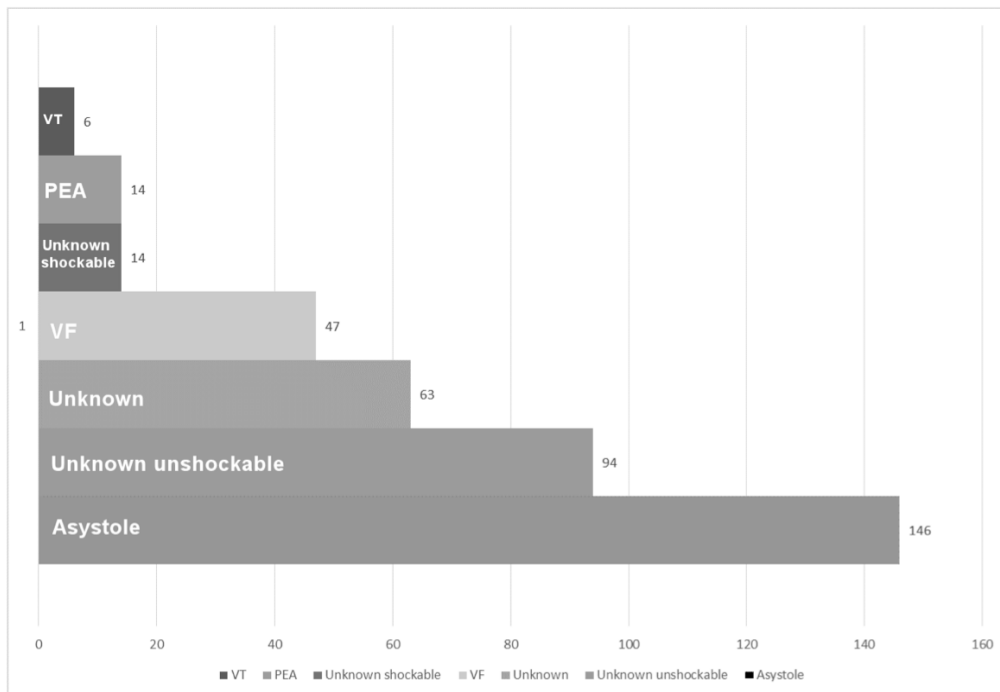
Table 1 - Patient demographics, out-of-hospital cardiac arrest (OHCA) characteristics and outcomes of OHCA cases in Northern Emirates, United Arab Emirates between February 2014 and March 2015.

Characteristics	Population (n=384) n (%)
Age (years)	
Mean±SD	50.9±21.1
Median (IQR)	53 (35.5, 65.0)
Gender	
Male	291 (76.0)
Female	93 (24.0)
Past medical history	
Heart disease	53 (13.8)
Diabetes mellitus	63 (16.4)
Hypertension	56 (14.6)
Yes, but unknown	152 (39.6)
Location type	
Home residence	208 (54.2)
Healthcare facility	10 (2.6)
Public/commercial building	36 (9.4)
Street/highway	71 (18.5)
Industrial place	20 (5.2)
Transport centre	1 (0.3)
Place of recreation	22 (5.7)
In EMS/private ambulance	2 (0.6)
Others	14 (3.6)
Time from receipt of call to scene arrival (mins)	
Median (IQR)	9 (6.1)
Arrest witnessed	
Not witnessed	140 (36.4)
Bystander	212 (55.2)
EMS	30 (7.8)
First arrest rhythm	
VT/VF/unknown shockable	67 (17.5)
Unknown unshockable	94 (24.5)
Asystole	146 (38.0)
Pulseless electrical activity	14 (3.6)
Unknown	63 (16.4)
Prehospital intervention	
Bystander CPR	115 (30.0)
Prehospital defibrillation	181 (47.1)
Bystander AED application	2
Bystander defibrillation	0
Time to first shock from EMS arrival (mins)	
Median (IQR)	8 (3.2)
Prehospital advanced airway	
Oral/nasal endotracheal tube	5 (1.3)
Laryngeal tube airway	2 (0.6)
Laryngeal mask airway	1 (0.3)
iGel	314 (81.8)
None	62 (16.1)
Location of cardiac arrest by Emirates	
Al-Sharjah	174 (45.3)
Ras al-Khaimah	56 (14.6)
Ajman	51 (13.3)
Al-Fujairah	34 (8.8)
Umm al-Quwain	16 (4.2)
Unknown	53 (13.8)
Outcomes	
ROSC prehospital	12 (3.1)
ROSC in emergency department	
Survived to admission	Not available
Survived to discharge	Not available
Post arrest CPC 1/2	Not available

EMS - emergency medical services, VF - ventricular fibrillation, VT - ventricular tachycardia, CR - cardiopulmonary resuscitation, RSC - return of spontaneous circulation, CPC - cerebral performance category, CPR - cardiopulmonary resuscitation, AED - automated external defibrillator, IQR - interquartile range, ROSC - return-of-spontaneous-circulation

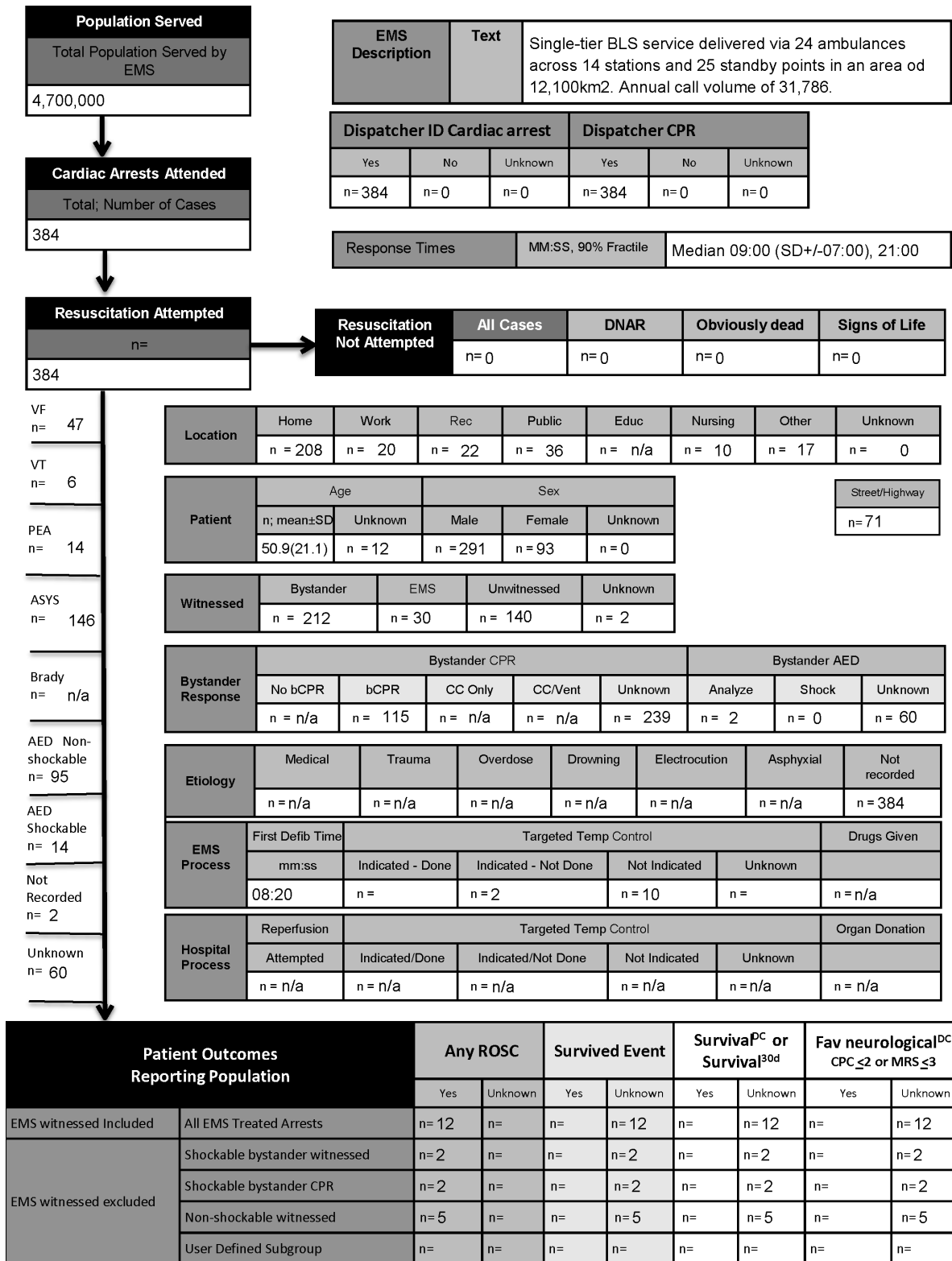**Figure 2 -** Location of out-of-hospital cardiac arrest (OHCA) cases in Northern Emirates, Arab Emirates between February 2014 and March 2015.

Figure 3 - Prevalence of presenting in out-of-hospital cardiac arrest (OHCA) cases in Northern Emirates, Arab Emirates between February 2014 and March 2015. VT - VT - ventricular tachycardia, PEA - pulse less electrical activity, VF - ventricular fibrillation

Population Served

Total Population Served by EMS
4,700,000

EMS Description	Text	Single-tier BLS service delivered via 24 ambulances across 14 stations and 25 standby points in an area od 12,100km2. Annual call volume of 31,786.

Dispatcher ID Cardiac arrest			Dispatcher CPR		
Yes	No	Unknown	Yes	No	Unknown
n= 384	n= 0	n= 0	n= 384	n= 0	n= 0

Response Times	MM:SS, 90% Fractile	Median 09:00 (SD+/-07:00), 21:00

Cardiac Arrests Attended

Total; Number of Cases
384

Resuscitation Attempted

n=
384

Resuscitation Not Attempted	All Cases	DNAR	Obviously dead	Signs of Life
	n= 0	n= 0	n= 0	n= 0

VF n= 47

VT n= 6

PEA n= 14

ASYS n= 146

Brady n= n/a

AED Non-shockable n= 95

AED Shockable n= 14

Not Recorded n= 2

Unknown n= 60

Location	Home	Work	Rec	Public	Educ	Nursing	Other	Unknown
	n = 208	n = 20	n = 22	n = 36	n = n/a	n = 10	n = 17	n = 0

Patient	Age		Sex			Street/Highway
	n; mean±SD	Unknown	Male	Female	Unknown	n=71
	50.9(21.1)	n = 12	n =291	n =93	n = 0	

Witnessed	Bystander	EMS	Unwitnessed	Unknown
	n = 212	n = 30	n = 140	n = 2

Bystander Response	Bystander CPR					Bystander AED		
	No bCPR	bCPR	CC Only	CC/Vent	Unknown	Analyze	Shock	Unknown
	n = n/a	n = 115	n = n/a	n = n/a	n = 239	n = 2	n = 0	n = 60

Etiology	Medical	Trauma	Overdose	Drowning	Electrocution	Asphyxial	Not recorded
	n =n/a	n = n/a	n = n/a	n = n/a	n = n/a	n = n/a	n = 384

EMS Process	First Defib Time	Targeted Temp Control				Drugs Given
	mm:ss	Indicated - Done	Indicated - Not Done	Not Indicated	Unknown	
	08:20	n =	n = 2	n = 10	n =	n = n/a

Hospital Process	Reperfusion	Targeted Temp Control				Organ Donation
	Attempted	Indicated/Done	Indicated/Not Done	Not Indicated	Unknown	
	n = n/a	n = n/a	n = n/a	n = n/a	n = n/a	n = n/a

Patient Outcomes Reporting Population		Any ROSC		Survived Event		Survival^{PC} or Survival^{30d}		Fav neurological^{DC} CPC $\leq$2 or MRS $\leq$3	
		Yes	Unknown	Yes	Unknown	Yes	Unknown	Yes	Unknown
EMS witnessed Included	All EMS Treated Arrests	n= 12	n=	n=	n= 12	n=	n= 12	n=	n= 12
EMS witnessed excluded	Shockable bystander witnessed	n= 2	n=	n=	n= 2	n=	n= 2	n=	n= 2
	Shockable bystander CPR	n= 2	n=	n=	n= 2	n=	n= 2	n=	n= 2
	Non-shockable witnessed	n= 5	n=	n=	n= 5	n=	n= 5	n=	n= 5
	User Defined Subgroup	n=	n=	n=	n=	n=	n=	n=	n=

Figure 4 - Full Utstein reporting data in Northern Emirates, Arab Emirates between February 2014 and March 2015. EMS - Emergency Medical Service, BLS - Basic Life Support, VF - ventricular fibrillation, ROSC - return-of-spontaneous-circulation, VT - ventricular tachycardia, ASYS - Asystole, CPR - cardiopulmonary resuscitation, AED - automated external defibrillator, DC - survival to discharge, 3od - survival at 30 days, MRS - modified Rankin Scale, mm;ss - time in minute:seconds format, vent - ventilations, DNAR - did not attempt resuscitation

home residence (58%), 2 at a healthcare facility, 2 in a public/commercial building (17% each) and one in a place of recreation (8.3%). Seven had a mechanical CPR device applied (58%), and nine had an advanced airway inserted (75%).

Discussion. The median age found in our study corresponds with data recently published from our colleagues in the Dubai PAROS data collection site (Dubai Corporation for Ambulance Services), who report a median age of 50.0 years (IQR 38.0, 63.0). Males accounted for 82.7% (n=405) of all arrests in the emirate of Dubai, and again, the majority of arrests (n=220, 54.3%) occurred at home. Of these 405 arrests, 205 (50.6%) were witnessed, similar to our findings. However, bystander CPR was only performed in 41 (10.5%) OHCA cases in Dubai. The majority of arrests in Dubai (n=362, 89.4%) were presumed cardiac in nature. Hospital survival data is available for Dubai, and an overall survival to discharge rate of 3% (n=12) with a cerebral performance score (CPC) of 1 or 2 in 11 (2.7%) of these cases.[2]

Many of the witnessed arrests in our study had a large delay in time before activation of the emergency response system. The reasons for this are unknown, but it could be hypothesized from previous studies and anecdotal reports provided by NA crews that many members of the public simply do not understand the time-critical nature of cardiac arrest, and may have trouble identifying the patient who needs immediate medical assistance. Utilisation of ambulance services in general is low in the Arab gulf region, as demonstrated in a study in 2013, where only 25% of patients presenting to the ED with acute coronary syndrome arrived via ambulance.[8] Cultural norms regarding death at home and being taken to the hospital may also have influenced the delay in seeking help.

The relatively low rate of bystander CPR may also be attributed to cultural norms, as highlighted in a study of CPR and AED utilization in Bahrain.[9] It may also be attributed to a lack of knowledge surrounding first aid and CPR in general. There is also no established, coordinated public access defibrillator scheme in the UAE. Although there are leadership wishes to promote public access defibrillation, take up of the initiative in the UAE has been suboptimal. Many members of the public are also afraid or hesitant to intervene and assist a person in need due to lack of knowledge, fear of litigation and uncertainty surrounding 'Good Samaritan' status. While a stand-alone 'Good Samaritan' law does not exist within the UAE, a Fatwa issued in 2010 by the Official Iftaa Center, General Authority of Islamic Affairs & Endowments states that first aid should be administered by all people in accordance with Sharia law. In accordance with this Fatwa, no criminal liability will attach to an individual, in respect of Sharia and UAE law, when they provide first aid to someone in need.[10]

The high incidence of cardiac arrests occurring in the emirate of Al-Sharjah can possibly be attributed to a number of factors, but requires urgent further research. The emirate of Sharjah is home to a large expatriate population, with over 37% from the Indian subcontinent (India, Pakistan, and Bangladesh).[11] This population are prone to developing CHD at a younger age,[12] a risk factor for OHCA. We cannot say this is a certain factor that influences the cardiac arrest rate in this Emirate, the proportion of emergency medical calls within the Emirate of Sharjah is indeed higher than other areas of the Northern Emirates service area. This could also partly be due to building design in the larger cities, which are home to many high-rise buildings, an independent predictor of OHCA survival.[13]

The results from this one-year of data collection support the implementation of certain initiatives. Ong et al[6] identified 5 potential strategies for improving survival rates in the participating PAROS countries. These include widespread community-based and systemic efforts to increase bystander CPR; investing in Public Access Defibrillation schemes, having a BLS EMS system, but investing in reducing response times; developing Advanced Life Support EMS systems and investing in hospital-based post-resuscitation care (cardiac arrest centers). The findings from this study support the continued need for system investment, public engagement and education and awareness campaigns for the general public and healthcare professionals on rapid recognition and management of OHCA. An interdisciplinary approach is essential to reduce mortality from OHCA. This approach needs to be guided by data. This data limitation is currently being addressed, since the findings of this study were collated, the NA LLC has worked with hospital sites in the Northern Emirates service area, who have begun the process to collect and enter OHCA data into the PAROS database. This will allow for construction of datasets representing all prehospital cardiac arrest cases in the UAE. By engaging a data collection site of PAROS, a clearer picture of OHCA outcomes in the UAE will be available in the future. The primary outcome data that will be available through publication of full PAROS datasets will be survival to hospital discharge, or survival

to 30 days post-cardiac arrest for those who have not yet been discharged from the hospital by the 30th day post-arrest, along with CPC on discharge.

There are several limitations to this study that need to be highlighted. Data collection was limited to data collected by NA crews in the prehospital setting utilizing PAROS forms and patient care records. Limited data was obtained on other prehospital variables, such as time from arrest to hospital, cases which were transported by other means, and any performed interventions during these transports. The cause of arrest was not confirmed by post-mortem examination due to the cultural standards.

A significant number of OHCA cases might still arrive at a hospital via private transport rather than by transport in an ambulance. Some of these cases may have been attended to by primary care/community care providers, pronounced dead at home, or not be conveyed to hospital at all. This possibly resulted in incomplete enrolment of patients into our study, which may introduce selection bias. Our own data collection is incomplete for several variables, and may not be totally representative of the true situation. Our inability to discuss findings beyond the prehospital care phase, and the missing data in Utstein reporting as a result, is an obvious limitation.

In conclusion, the data collected in this study documented a low ROSC rate for OHCA patients in the Northern Emirates. The findings of this study are to be expected given the low prevalence of early EMS activation, low rates of bystander CPR, and the poor availability of public-access defibrillators. Further collaborative research is urgently needed on the topic of OHCA in the UAE as the current literature on the topic is sparse.

References

1. Bin Salleeh H, Gabralla K, Leggio W, Al Aseri Z. Out-of-hospital adult cardiac arrests in a university hospital in central Saudi Arabia. *Saudi Med J* 2015; 36: 1071-1075.

2. Ong MEH, Shin S Do, De Souza NNA, Tanaka H, Nishiuchi T, Song KJ, et al. Outcomes for out-of-hospital cardiac arrests across 7 countries in Asia: The Pan Asian Resuscitation Outcomes Study (PAROS). *Resuscitation* 2015; 96: 100-108.

3. Batt A, Al-Hajeri A, Minton M, Haskins B, Cummins F. National Ambulance Northern Emirates PAROS Study Annual Report 2015. Abu Dhabi (UAE): Pan-Asian Resuscitation Outcomes Study (PAROS); 2015.

4. Loney T, Aw T, Handysides D, Raghib A, Blair I, Grivna M, et al. An analysis of the health status of the United Arab Emirates: the "Big 4" public health issues. *Glob Health Action* 2013; 1: 1-8.

5. Euromonitor International. United Arab Emirates country profile [Cited 2013 December 6]. Available from: http://www.hdcglobal.com/upload-web/cms-editor-files/21bc5b40-5eff-40e8-b4ff-5b6a20931fed/file/United_Arab_Emirates_Country_Profile.pdf

6. Ong ME, Shin SD, Tanaka H, Ma MH, Khruekarnchana P, Hisamuddin N, et al. Pan-Asian Resuscitation Outcomes Study (PAROS): rationale, methodology, and implementation. *Acad Emerg Med* 2011; 18: 890-897.

7. Perkins GD, Jacobs IG, Nadkarni VM, Berg RA, Bhanji F, Biarent D, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: update of the Utstein Resuscitation Registry Templates for Out-of-Hospital Cardiac Arrest: a statement for healthcare professionals from a task force of the International Liaison Committee on Resuscitation (American Heart Association, European Resuscitation Council, Australian and New Zealand Council on Resuscitation, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa, Resuscitation Council of Asia); and the American Heart Association Emergency Cardiovascular Care Committee and the Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation. *Circulation* 2015; 132: 1286-300.

8. AlHabib KF, Alfaleh H, Hersi A, Kashour T, Alsheikh-Ali AA3, Suwaidi JA, et al. Use of emergency medical services in the second gulf registry of acute coronary events. *Angiology* 2014; 65: 703-709.

9. Merrigan OH. Abstract 229: Are there any cultural barriers to automated external defibrillator use in Middle Eastern Countries? *Circulation* 2015; 124 (Suppl 21): A229-A229.

10. Kelly R. "Good Samaritan" principles in the UAE : legal liabilities when administering first aid. [Cited 2015 Jun 14]. Available from: http://www.clydeco.com/insight/updates/view/good-samaritan-principles-in-the-uae-legal-liabilities-when-administering-f

11. Khamis J. Indians, Pakistanis make up 37% of Dubai, Sharjah, Ajman population. Gulf News [Internet]. Abu Dhabi; 2015 Aug 6; Available from: http://gulfnews.com/news/uae/society/indians-pakistanis-make-up-37-of-dubai-sharjah-ajman-population-1.1562336

12. Enas E, Garg A, Davidson M, Nair V, Huet B, Yusuf S. Coronary heart disease and its risk factors in first-generation immigrant Asian Indians to the United States of America. *Indian Heart J* 1996; 48: 343-553.

13. Drennan IR, Strum RP, Byers A, Buick JE, Lin S, Cheskes S, et al. Out-of-hospital cardiac arrest in high-rise buildings: delays to patient care and effect on survival. *CMAJ* 2016; 188: 413-419.