Communicating resuscitation

The importance of documentation in cardiac arrest

Amal A. Bakhsh, *MBBS,* ***Abdulrahman R. Bakhsh,*** *MBBS,* ***Zainab A. Karamelahi,*** *MBBS,* ***Abdullah A. Bakhsh,*** *MBBS, FAAEM,* ***Abeer M. Alzahrani,*** *MBBS,* ***Lojain M. Alsharif,*** *MBBS,* ***Yasmin M. Sharton,*** *MBBS,* ***Afnan K. Alotaibi,*** *MBBS,* ***Khadeja O. Basharahil,*** *MBBS.*

ABSTRACT

الأهداف: تقييم عملية توثيق الملفات خلال إجراء الإنعاش القلبي الرئوي بداخل المستشفى، وتهدف ثانوياً لرصد إجراءات الإنعاش القلبي الرئوي و حصيلة مخرجاتها.

الطريقة: أجريت دراسة استعادية ل 360 نموذج انعاش قلبي رئوي والسجلات الطبية خلال الفترة بين عام 2015م و 2016م في مستشفى الملك فهد العام، مستشفى الملك عبد العزيز العام (المحجر) و مستشفى الثغر بجدة.

النتائج: لم يتم توثيق المخرجات العصبية والخروج من المستشفى لمرضى الإنعاش القلبي الرئوي. لم يتم توثيق الجنس بنسبه 9 (2.5%) والجنسية بنسبة (3.3%) وإعلان حالات الإنعاش القلبي في المستشفى بنسبه 130 (36%)، التخطيط المبدئ بنسبة 10 (2.8%)، الوقت إلى وضع أنبوب تنفس بنسبة 154 (57.2%) والوقت إلى وصول طبيب القلب بنسبة 181 (50.27%)، والوقت إلى وصول طبيب التخدير بنسبه 145 (40.27%).

الخاتمة: ننصح بإستخدام نموذج موحد للانعاش القلبي الرئوي بجميع المستشفيات ومتابعة المخرجات العصبية ومعدل النجاة بعد الخروج.

Objectives: To primarily assess documentation during in-hospital cardiopulmonary arrest resuscitation and to secondarily observe cardiopulmonary resuscitation event and outcome variables.

Methods: A retrospective review of 360 code blue forms and medical records at King Fahad General Hospital, King Abdulaziz General Hospital (Almahjar), and Althghar Hospital in Jeddah was performed between 2015 to 2016.

Results: Survival to discharge rates and neurological outcomes were not documented at all. Other undocumented variables include gender 9 (2.5%), nationality 12 (3.3%), code blue announcement time 130 (36%), initial rhythm 10 (2.8%), time to airway placement 154 (57.2%), time to cardiology arrival 181 (50.27%), and time to anesthesia arrival 145 (40.27%).

Conclusion: We strongly recommend the use of standardized cardiopulmonary arrest sheets among all hospitals and follow up of neurological outcomes and survival to discharge as outcome variables.

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From the Department of Emergency Medicine (Bakhsh AR, Alzahrani, Alsharif, Bakhsh AA, Sharton, Alotaibi, Basharahil), King Abdulaziz University Hospital, Department of Primary Care (Karamelahi), King Fahah General Hospital (Bakhsh AR), Ministry of Health, Jeddah, Kingdom of Saudi Arabia.

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Address correspondence and reprint request to: Dr. Abdullah A. Bakhsh, Department of Emergency Medicine, King Abdulaziz University Hospital, Jeddah, Kingdom of Saudi Arabia.
E-mail: aarbakhsh@kau.edu.sa
ORCID ID: https://orcid.org/0000-0003-1224-9367

Data collection is an essential step to measure the quality of in-hospital cardiopulmonary resuscitation (CPR) provided to victims of cardiac arrest. The Utstein style guidelines (a set of guidelines for uniform reporting of cardiac arrest) for the documentation and reporting of in-hospital cardiac arrests were published in 1997 to reduce the variation in reporting styles and survival rates.[1] This style focuses

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on 4 sets of variables to document and report: hospital, patient, arrest, and outcome variables.[1] The widespread collection of this information was hoped to facilitate both intra-hospital and large-scale inter-hospital comparison and research.[2] In 2010, the American Heart Association (AHA) emphasized on the importance of data collection for cardiac arrest and identified essential elements of a high quality resuscitation system that includes: measurement, benchmarking, and providing feedback to influence change.[1,2] Several countries have developed national cardiac arrest registries for monitoring and quality improvement purposes.[3] This is a simple but powerful database that allows cities to collect a small set of performance measures from on-scene first responders, and link it with outcome data from hospitals.[4] This would require Emergency Medical Services (EMS) and hospitals to standardize cardiac arrest data collection. Despite similarities in CPR documentation among Ministry of Health Hospitals in Jeddah, a standard form does not exist for the reporting of cardiac arrest. Communities that do not measure their cardiac arrest outcomes are not only unable to gauge their performance, but lack a reference point to determine the impact of any implemented quality improvement efforts.[5] The aim of our study was to examine the current cardiac arrest documentation within Ministry of Health hospitals in the city of Jeddah, and its compliance with the Utstein style template. The secondary aim was to assess cardiac arrest event variables (incidence of return of spontaneous circulation (ROSC), initial rhythm, time to first dose of epinephrine, and time to airway placement).

Methods. Institutional Review Board (IRB) and ethical approval was obtained from the Ministry of Health (MOH) to conduct a retrospective chart review of CPR forms at 3 Ministry of Health hospitals in Jeddah (King Fahad Hospital, Althaghar Hospital, and King Abdulaziz General Hospital) between 2015 and 2016. The entire city of Jeddah is covered by the 3 MOH hospitals and serve between 90,000 to 110,000 patients per year. All data elements from in-hospital CPR records were collected by the study investigators and compared to the Utstein guidelines for cardiac arrest resuscitation reporting. Each researcher was trained on collection of data using the Utstein method. Researchers collected data variables directly from code blue sheets. Additional data variables were collected manually by going through patients' paper charts. We included 360 non-traumatic cardiac arrests above the age of 18 years. Pregnant, Do Not Resuscitate (DNR), traumatic arrests, and age less than 18 years were excluded. For patients with multiple cardiac arrests, only the first episode was included.

Statistical analysis. Descriptive statistics were used to describe the demographic characteristics, initial rhythm, outcomes, incidence of initial rhythm, mean time of first epinephrine dose, mean time of airway placement, mean time of first defibrillation, mean time of CPR call, mean time of cardio team arrival, incidence of ROSC and death overall and separately in each hospital. The mean and standard deviations were reported for continuous variables. Frequencies and percentages were reported for categorical variables. One-way ANOVA test was carried out to compare the mean time of first epinephrine dose, airway placement, first defibrillator shock, CPR call and cardio arrival in 3 hospitals. Kruskal-Wallis test was carried out to see the relationship between first epinephrine dose time and the categories of ROSC in 3 hospitals; and, between the time taken to insert airway and the categories of ROSC in 3 hospitals.

All statistical tests were carried out in 95% confidence interval. All analysis was performed using the Statistical Package for Social Science (SPSS), version 20 (IBM, Armonk, NY, USA).

Results. This retrospective chart review study involved a total of 360 patients who suffered in-hospital cardiac arrest in King Fahad Hospital, Althagr Hospital and King Abdulaziz Hospital between 2015 to 2016. Among the 360 victims, 212 (58.9%) were male, 139 (38.6%) were female and 9 (2.5%) had undocumented genders. The mean±SD age of all patients was 60.78±19.91 years. Half of our patients 182 (50.6%) were Saudi Arabian, 166 (46.1%) were non-Saudi and 12 (3.3%) had undocumented or unclear nationalities. Initial rhythm was asystole for the majority of cases 213 (59.2%), followed by pulseless electrical activity (PEA) 106 (29.4%) and bradycardia 23 (6.4%). The initial rhythm was not documented in 10 (2.8%) cases. Return of spontaneous circulation (ROSC) was seen in 161 (44.7%) patients while the remaining 199 (55.3%) died. Sixty-five (18.1%) patients had sustained ROSC lasting more than 20 minutes but less than or equal to 24 hours. Mean±SD time to first dose of epinephrine was 0:05±1:04 (hh:mm), to airway placement was 0:07±0:05 (hh:mm), to first defibrillator shock was 0:11±0:05 (hh:mm), to code blue announcement was 0:00±0:00 (hh:mm), to cardiology arrival was 0:04±0:16 (hh:mm), and to anesthesia arrival was 0:0 ±0:04 (hh:mm) (**Table 1**, **Table 2**).

Time taken to place the airway was not documented

at King Abdulaziz Hospital, neither was code blue announcement time at Althagr Hospital. Fifty-five cases at King Fahad Hospital and 36 cases at Althagr Hospital had definitive airways prior to the onset of cardiac arrest. Cardiology arrival time was not documented for 108 cases at Althagr Hospital and for 54 cases at King Abdulaziz Hospital. The number of undocumented events were relatively low at King Fahad Hospital in comparison with the other 2 hospitals.

Asystole was the predominant initial rhythm at King Fahad 103 (85.8%) and Althaghr hospitals 78 (65.0%). Whereas, PEA was the most common initial rhythm at King Abdulaziz Hospital 83 (69.2%). None of the patients in King Abdulaziz hospital had bradycardia and ventricular tachycardia (VT) as the initial rhythm. Initial rhythm was not documented for 5 patients (4.2%) at King Fahad Hospital, one patient (0.8%) at Althagr Hospital and 3 patients (2.5%) at King Abdulaziz Hospital (**Table 3**).

The reported incidence of ROSC in our study was 45.5% for King Fahad Hospital, 40% for King Abdulaziz Hospital, and 48.3% for Althaghar Hospital.

There was no statistically significant difference in the time taken to administer first dose of epinephrine across all 3 hospitals. Airway placement time was 2 minutes faster at King Fahad Hospital than Althagr Hospital (p=0.021). No significant difference in first defibrillator shock time was found in the 3 hospitals. Code blue announcement time was the same at King Fahad Hospital and King Abdulaziz Hospital (p=0.125). Time to Cardiology arrival was not significantly different across the 3 hospitals (**Table 4**).

Kruskal-Wallis test reported the distribution of time taken to administer the first epinephrine dose was not the same across all the categories of ROSC (p=0.003). It also revealed the distribution of time taken to insert airway is the same across the categories of ROSC (p=0.390) (**Table 5**).

Survival to discharge rates and neurological outcomes were not documented at all. Other not documented variables include gender 9 (2.5%),

Table 1 - Gender, nationality, initial rhythm, final outcome and ROSC time are reported in number and percentages for all patients who undergone cardiac arrest in 3 hospitals (n=360).

Characteristics	n	(%)
Gender		
Male	212	(58.9)
Female	139	(38.6)
Unknown	9	(2.5)
Nationality		
Saudi	182	(50.6)
Non-Saudi	166	(46.1)
Unknown	12	(3.3)
Initial rhythm		
Asystole	213	(59.2)
VF	6	(1.7)
PEA	106	(29.4)
Bradycardia	23	(6.4)
VT	1	(0.3)
Not documented	10	(2.8)
Not clear	1	(0.3)
Final outcome		
ROSC	161	(44.7)
Death	199	(55.3)
ROSC		
≤20 min	20	(11.4)
>20 min to ≤ 24 hr	65	(18.1)
>24 hr	20	(5.6)
Never achieved	199	(55.3)
Unclear	35	(9.7)

ROSC - return of spontaneous circulation, VF- Ventricular fibrillation, PEA - pulseless electrical activity, VT - ventricular tachycardia

Table 2 - Age, CPR start time, CPR end time, code blue announcement time, cardiology arrival time, anesthesia arrival time, first defibrillator shock time, airway placement time and time to deliver first epinephrine dose for all clearly documented patients undergone cardiac arrest at three hospitals are expressed in mean, SE, SD, minimum and maximum values. (N=360).

Variables	n	Mean	SE	SD	Min	Max
Age in years	352	60.78	1.06	±19.91	0	104
CPR start to first dose of epinephrine time (mm:ss)	351	5:00	3:00	±1:04	0:00	20:00
CPR start to airway placement time (mm:ss)	115	7:00	0:00	±5:00	0:00	38:00
CPR start to first defibrillator shock time (mm:ss)	26	11:00	1:00	±5:00	1:00	27:00
CPR start to code blue announcement time (mm:ss)	230	0:00	0:00	±0:00	0:00	0:08
CPR start to cardiology arrival time (mm:ss)	179	4:00	1:00	±16:00	0:00	3:41
CPR start to Anesthesia arrival time (mm:ss)	215	2:00	0:00	±4:00	0:00	32:0

CPR -cardiopulmonary resuscitation, SE - standard error- SD - standard deviation, Min - minimum, Max - maximum, mm:ss - minutes:seconds

nationality 12 (3.3%), code blue announcement time 130 (36%), initial rhythm (10, 2.8%), time to airway placement 154 (57.2%), time to cardiology arrival 181 (50.27%), and time to anesthesia arrival 145 (40.27%) (**Table 6**).

Epinephrine administration in the first 0-1 minute after CPR initiation was associated with ROSC in 102 (28.8%) patients. Administration of Epinephrine between 2-3 minutes after CPR initiation was associated with ROSC in 32 (9%) patients.

Table 3 - Incidence of initial rhythm for all patients in each hospital are reported as numbers and percentages (n=120 in each hospital).

Initial rhythm of the hospital	n	(%)
King Fahad Hospital		
Asystole	103	(85.8)
VF	2	(1.7)
PEA	7	(5.8)
Bradycardia	2	(1.7)
VT	1	(0.8)
Not documented	5	(4.2)
Althagr Hospital		
Asystole	78	(65.0)
VF	2	(1.7)
PEA	16	(13.3)
Bradycardia	21	(17.5)
VT	2	(1.7)
Not documented	1	(0.8)
King Abdulaziz Hospital		
Asystole	32	(26.7)
VF	2	(1.7)
PEA	83	(69.2)
Bradycardia	Nil	(0.0)
VT	Nil	(0.0)
Not documented	3	(2.5)

VF- Ventricular fibrillation, PEA - pulseless electrical activity, VT - ventricular tachycardia

Discussion. During in-hospital cardiac arrest resuscitation documentation, full compliance with the Utstein reporting guidelines were not met in this study. Resuscitation aims to return patients to their level of health before the cardiac arrest.[5] Majority of cardiopulmonary arrest outcomes studies use survival to discharge rates and neurological outcomes to report the performance of cardiopulmonary arrest resuscitation.[6-9] However, in our study, survival to discharge rates and neurological outcomes were the most undocumented items. This is explained by the lack of a tracking system to follow up patients discharged from the hospital. This barrier was also observed at King Saud Medical City in Riyadh.[10] Therefore, we were unable to use survival and neurological outcomes as outcome indicators in our study.

Return of spontaneous circulation (ROSC) was used as an outcome indicator in our study. The overall ROSC rate was 44.7%. Return of spontaneous circulation was documented for every patient on the code blue sheet during our study period. A tertiary care facility in Riyadh showed ROSC rates of 30.5%.[10] This variation could be due to differences in sample size, hospital variables, patient variables, and event variables. We could not find an abundance of studies measuring in-hospital cardiac arrest performance in Saudi Arabia. Return of spontaneous circulation rates in other countries were 44%, 49%, and 49.3%.[11-13] Our study demonstrated the acute resuscitation survival rate was 18.1% and postresusctiation survival rate was 5.6%.

Table 4 - One-way ANOVA test to compare the mean time of first epinephrine dose, airway placement, first defibrillator shock, CPR call and cardio arrival in 3 hospitals. (N=360).

Variable	Hospital (i)	Vs hospital (j)	Mean time difference (I – j)	df	*P*-value
First epinephrine dose time (minutes)	King Fahad	Althagr	-0:03	2	0.933
		King Abdulaziz	-0:07		0.702
	Althagr	King Abdulaziz	-0:10		0.476
Airway placement time (minutes)	King Fahad	Althagr	0:02	1	0.021
First defibrillator shock time (minutes)	King Fahad	Althagr	0:04	2	0.607
		King Abdulaziz	0:07		0.214
	Althagr	King Abdulaziz	0:03		0.551
Code blue announcement time (minutes)	King Fahad	King Abdulaziz	0:00	1	0.125
Cardiology arrival time (minutes)	King Fahad	Althagr	0:06	2	0.469
		King Abdulaziz	0:06		0.061
	Althagr	King Abdulaziz	0:00		0.999

df - degree of freedom, ANOVA -Analysis of variance, CPR - CPR -cardiopulmonary resuscitation

Table 5 - Kruskal-Wallis test to see the relationship between i. ROSC and time taken to give first dose epinephrine; ii. relationship between ROSC and time taken to insert airway. (N=360).

Null hypothesis	*P*-value	Decision
The distribution of time taken to administer first epinephrine dose is the same across categories of ROSC	0.003	Reject the null hypothesis
The distribution of time taken to insert airway is the same across categories of ROSC	0.390	Retain the null hypothesis

ROSC - return of spontaneous circulation

Table 6 - Number and percentages for all undocumented variables.

Variables	Undocumented	(%)
Gender	9	(2.5)
Nationality	12	(3.3)
Code blue announcement time	130	(36.0)
Initial rhythm	10	(2.8)
Time to airway placement	154	(57.2)
Time to cardiology arrival	181	(50.27)
Time to Anasthesia arrival	145	(40.27)
Survival to discharge	360	(100)
Cerebral performance category	360	(100)

Other important variables that were not adequately documented included the initial rhythm, time to airway placement, code blue announcement times, and CPR team member arrival times. Frequently, the initial rhythm was documented as "unrecordable". This indicates the lack of team communication or lack of familiarity with the common advanced cardiac life support rhythm terminology. One site did not include time to airway placement on their code blue sheet and another site did not include code blue announcement time during our study period. This is explained by the lack of a standardized code blue form across all 3 sites. Another common observation was that CPR team members place their stamps and signatures over arrival times, obscuring arrival time data.

The most common initial rhythms were asystole (59.2%) and PEA (29.4%). Ventricular fibrillation (VF)/Pulseless VT were the least initial rhythms in our study. This is consistent with other in-hospital cardiac arrest studies.[14,15] The high prevalence of asystole/PEA as the initial rhythm for in-hospital cardiac arrests can be explained by differences in pathophysiology; in-hospital cardiac arrests are mostly precipitated by hypoxia, hypotension, acidosis, electrolyte abnormalities, hypovolemia, and more, which are more likely to cause asystole/PEA.[16,17]

The first dose of Epinephrine was given within 3-5 minutes of cardiac arrest recognition. This is in compliance with the AHA guidelines.[18] An important association in our study is that the ROSC rates are higher with earlier Epinpherine administration. Studies suggest 3 phases are present in cardiac arrest: electrical, circulatory, and metabolic.[19] The circulatory phase (within 10 minutes of arrest) focuses on perfusion, where epinephrine may improve cardiac perfusion.[19] A previous study showed that patients receiving Epinephrine less than 9 minutes after cardiac arrest demonstrate the best outcomes.[19]

It is important to note that all patient records were paper charts and were stored manually in the medical record department. The mechanism in retrieving patients who suffered cardiopulmonary arrest manually, likely introduced a major selection bias.

In conclusion, we recommend the use of a standardized form in compliance with the Utstein guidelines for in-hospital cardiac arrest resuscitation documentation. The development of a tracking system to follow up patients who are discharged after cardiac arrest will allow for collection of neurological outcome data.

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Clinical Practice Guidelines

Clinical Practice Guidelines must include a short abstract. There should be an Introduction section addressing the objective in producing the guideline, what the guideline is about and who will benefit from the guideline. It should describe the population, conditions, health care setting and clinical management/diagnostic test. Authors should adequately describe the methods used to collect and analyze evidence, recommendations and validation. If it is adapted, authors should include the source, how, and why it is adapted? The guidelines should include not more than 50 references, 2-4 illustrations/tables, and an algorithm.