Original Article

Cardiac arrest recognition and telephone CPR by emergency medical dispatchers

Mark Anthony Attard Biancardi, Peter Spiteri, Maria Pia Pace

Abstract

Introduction: Emergency Medical Service (EMS) systems annually encounters about 275 000 out-of-hospital cardiac arrest (OHCA) patients in Europe and approximately 420,000 cases in the United States.[1] Survival rates have been reported to be poor with approximately 10% survival to hospital discharge.[2] The chance of surviving from an OHCA is highly associated with Emergency Medical Dispatchers' (EMD) recognition of cardiac arrest, early bystander cardiopulmonary resuscitation (CPR), and early defibrillation.[3-6]

Method: This study was a simulation based study. All emergency nurses who were eligible by training to answer 112 calls and activate the EMS were included in this study. The simulations were run by two experienced ED nurses who followed predefined scripts. The two key questions that the authors were after included ascertaining patient responsiveness and breathing status. EMDs who offered telephone assisted CPR (tCPR) were noted and observed.

Results: The mean percentage recognition of out of hospital cardiac arrest by the Maltese EMDs was 67%. 28% of EMDs who recognized cardiac arrest asked both questions regarding patient's responsiveness and breathing whilst only 8% of EMDs who did not recognize cardiac arrest asked both questions. The mean percentage of telephone assisted CPR was 58%.

Conclusion: When compared to other European countries, OHCA recognition by Maltese EMDs needs to improve. However, given that the local EMDs have no formal guidelines or algorithms for their use during 112 calls, results are encouraging to say the least especially in telephone assisted CPR. With education and simulation training, these numbers should improve

Key Words

Emergency Medical Services, Emergency Medical Dispatchers, Out-of-Hospital Cardiac arrest, cardiopulmonary resuscitation, Telephone assisted CPR

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Introduction

Emergency Medical Service (EMS) systems annually encounters about 275 000 out-of-hospital cardiac arrest (OHCA) patients in Europe and approximately 420,000 cases in the United States.[1] Survival rates have been reported to be poor with approximately 10% survival to hospital discharge. [2] The chance of surviving from an OHCA is highly associated with Emergency Medical Dispatchers' (EMD) recognition of cardiac arrest, early bystander cardiopulmonary resuscitation (CPR), and early defibrillation.[3-6] In communities where this chain of survival is strong, survival rates can reach 20% - 40% in witnessed OHCA.[7-8] In Malta the survival to hospital discharge in OHCA is 3% with a rate of bystander CPR at around 38%. [9] Similarly, in the UK the rate of bystander CPR is about 40%.[10] In a study done in Sweden, Hasselqvist *et al*.[11] found that the rate of bystander CPR was 51%.

Decreasing the time to treatment is crucial for improving outcomes in cases of cardiac arrest.[12-13] As stated in American and European guidelines, the most important response measures that currently can be taken outside a hospital setting are recognizing early that a cardiac arrest is occurring, placing an alarm call, performing CPR, and performing defibrillation.[14-15] EMD who take emergency calls play a key role in the performance of bystander CPR prior to the arrival of EMS personnel on the scene.[16-17] EMD instructions for CPR can double the frequency of bystander CPR. [18] The identification of cardiac arrest via telephone, however, is extremely difficult, especially when a collapsed individual has agonal respiration.[6,19–20] Although the ability to recognize OHCA is a challenging task, in certain European countries such as Finland, the capacity to identify OHCA patients has been reported to be as high as 70–83%.[21–23] Recognition of cardiac arrest by the EMD is thus essential, so that telephone assisted CPR (tCPR) and referral to an automated external defibrillator (AED) can be initiated.

There are certain factors which act as barriers in tCPR. The study done by Bang *et al.*[24], showed that tCPR was unlikely if the caller was not at the scene and that the emotional state of the caller influenced initiation of tCPR. In addition to this study, several studies have shown how the emotional state of the caller affected OHCA recognition and precluded tCPR.[25–28] Dealing with callers who are healthcare professionals can also pose a problem. Castren *et al.* [29] described the phenomenon of significantly lower OHCA recognition in professionals than non-professional bystanders, and less use of the algorithm by EMD when dealing with calls from healthcare professionals. The aim of this study was to explore the recognition of OHCA by our local EMD and the frequency of telephone assisted CPR offered to bystanders.

Method

This study was a simulation based study involving two hypothetical 112 calls. Two scenarios involving cardiac arrest victims were chosen from a pool of six common 112 calls that our control room in the Emergency Department at Mater Dei Hospital receive. Scenarios were chosen since we had no access to actual 112 recordings involving cardiac arrest victims. All emergency nurses who were eligible by training to answer 112 calls and activate the EMS were included in this study. The simulations were run by two experienced ED nurses who were not included in the study. Verbal consent for recruitment was obtained from the participants, however, to minimize bias the reason behind these simulations or feedback on the simulation itself was not disclosed to the participants. The simulation was run in english or maltese based on the EMD's preference.

The assessors pretended to be bystanders to a collapsed victim calling the ambulance control room and followed a pre-defined script (*Table 1 – Scenario 1 & table 2 – Scenario 2).* Certain key questions which the authors thought was important to determine OHCA were discussed and determined before the start of the simulation and the assessors were asked to tick certain boxes on the script if these pertinent questions were asked by the participants. The two key questions were:

- to determine patient's response by vocal and/or tactile stimulation and
- Whether the patient is breathing normally.

In addition, during the simulation, note was made on the type of ambulance code dispatched (Red, Orange or Blue – *(Table 3 – Types of Ambulance codes)*) and whether telephone assisted cardio pulmonary resuscitation was offered to bystanders if OHCA was recognized. As a final remark, participants were asked to give their impression on what they were dealing with.

Results

Out of 54 eligible ED nurses, 52 took part in this simulation based study. In Case 1 where you had an unresponsive patient, who is not breathing, 92% (48/52) recognized an out of hospital cardiac arrest. TCPR was started in 75% (36/48) of cases. Eighty-eight percent (88% - 42/48) dispatched a code red and 12% (6/48) dispatched a code orange. Only 8% (4/52) did not recognize an OHCA with 2 code reds and 2 code orange dispatched *(Table 4 - Results Case 1 – Unresponsive not breathing patient).* In Case 2 where you had an unresponsive patient, with agonal breathing, 42% (22/52) recognized an OHCA. TCPR was started in 41% (9/22) of the cases. Seventy-seven percent (77% - 17/22) dispatched a code red and 23% (5/22) dispatched a code orange. Fifty-eight percent (58% - 30/52) did not recognize an OHCA with 10 code reds and 20 code orange dispatched *(Table 5 - Results Case 2 – Unresponsive patient with agonal breathing).*

Table 1: *Scenario 1*

Caller	My father is not feeling well. We need an ambulance urgently!
Dispatcher	What happened?
Caller	He had shortness of breath but now he is not talking!
Dispatcher	**If you call him or stimulate him, does he open his eyes or respond in any way?**
Caller	No
Dispatcher	**Is he breathing?**
Caller	No
Dispatcher	Takes details and address? cardiac arrest – dispatch code red
Dispatcher	***Do you know how to perform CPR?***
Caller	No
Dispatcher	***Place left hand over the centre of the chest and the right hand over the left hand locking both hands together and with the heel of your left hand press hard and fast – 30 compressions. Then give 2 breaths by tilting the head back, pinch the nose and blow twice in mouth.***

Dispatcher impression of case

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Telephone CPR by dispatcher – Y / N

Table 2*: Scenario 2*

Caller	(A lot of shouting) We need an ambulance urgently!
Dispatcher	What happened?
Caller	He's in his chair..... He vomited as well!!!!
Dispatcher	Is he talking to you?
Caller	No!
Dispatcher	**If you call him or stimulate him, does he open his eyes or respond in any way?**
Caller	No
Dispatcher	**Is he breathing?**
Caller	What do you mean?
Dispatcher	**Is he breathing normally?**
Caller	Very shallow and slowly
Dispatcher	Takes details and address? cardiac arrest – dispatch code red
Dispatcher	***Do you know how to perform CPR?***
Caller	***No***
Dispatcher	***Place left hand over the centre of the chest and the right hand over the left hand locking both hands together and with the heel of your left hand press hard and fast – 30 compressions. Then give 2 breaths by tilting the head back, pinch the nose and blow twice in mouth.***

Dispatcher impression of case

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Telephone CPR by dispatcher – Y / N

***Table 3**: Types of Ambulance codes*

Code RED	Ambulance response with **blue lights & siren for potentially life threatening** (Category A) **calls**. The ambulance response is Emergency Nurse led with ambulance support personnel and a doctor may be dispatched as required from health centre or otherwise.
Code ORANGE	Ambulance response with **blue lights & siren as required for urgent but non-life-threatening** (Category B) **calls** which require support by an emergency nurse according to dispatch protocol.
Code BLUE	Ambulance response with **blue lights only for 112** (Category C) **calls which do not require support by an emergency nurse** according to dispatch protocol.

***Table 4:** Results Case 1 – Unresponsive not breathing patient*

Recognition of OHCA	92% (48/52)	Missed OHCA	8% (4/52)
Started tCPR	75% (36/48)	Started tCPR	0
Dispatched code Red	88% (42/48)	Dispatched code Red	50% (2/4)
Dispatched code Orange	12% (6/48)	Dispatched code Orange	50% (2/4)

***Table 5**: Results Case 2 – Unresponsive patient with agonal breathing*

Recognition of OHCA	42% (22/52)	Missed OHCA	58% (30/52)
Started tCPR	41% (9/22)	Started tCPR	0
Dispatched code Red	77% (17/22)	Dispatched code Red	33.3% (10/30)
Dispatched code Orange	23% (5/22)	Dispatched code Orange	66.7% (20/30)

***Table 6**: EMD impressions in unrecognised OHCA*

Cardiac event/MI x8	Hypovolaemia x1
Hypoglycaemia x8	HI x1
Syncope x7	AAA x1
CVA x4	Airway compromise x1
Choking x2	Gastritis x1

***Table 7**: OHCA recognized by EMDs*

Case 1 – unresponsive and not breathing	**Case 2 – unresponsive with agonal breathing**
29% asked both relevant questions (14/48)	27% asked both relevant questions (6/22)
4% asked about responsiveness only (2/48)	0% asked about responsiveness only (0/22)
64.5% asked about breathing only (31/48)	68% asked about breathing only (15/22)
2% did not ask any questions (1/48)	5% did not ask any questions (1/22)
	73% assumed that if the patient is not talking therefore the patient is unresponsive and did not ask for response (16/22)

The mean percentage recognition of out of hospital cardiac arrest by the Maltese EMDs over these two cases was of **67%.** The mean percentage of tCPR over these two cases was of **58%.**

In the unrecognized OHCA over both cases, the impressions that the EMDs gave were mainly myocardial infarctions and hypoglycaemias and syncope. Others included cerebrovascular accidents, choking, hypovolaemia, head injury, ruptured abdominal aorta aneurysm, compromised airway and gastritis *(Table 6* - EMD impressions in unrecognised OHCA*).*

If one had to look at the two key questions that EMDs had to ask to ascertain cardiac arrest:

Of those who recognized an OHCA (*Table 7 - OHCA recognized by EMDs*):

- 28% asked both relevant questions
- 2% asked about responsiveness only
- 66% asked about breathing only
- 3.5% did not ask any questions

Of those who did not recognize OHCA (*Table 8 - OHCA not recognized by EMDs*):

- 8.5% asked both relevant questions
- 19% asked about responsiveness only
- 51.5% asked about breathing only
- 21% did not ask any questions

Table 8*: OHCA not recognized by EMDs*

Case 1 – unresponsive and not breathing	**Case 2 - unresponsive with agonal breathing**
0% asked both questions (0/4)	17% asked both questions (5/30)
25% asked about responsiveness only (1/4)	13% asked about responsiveness only (4/30)
50% asked about breathing only (2/4)	53% asked about breathing only (16/30)
25% did not ask any questions (1/4)	17% did not ask any questions (5/30)

Discussion

The EMS locally is mainly run by emergency nurses and the EMD is solely run by emergency nurses. To be eligible to practice as an EMD, an emergency nurse needs to have worked for at least 1 year in the emergency department and completed successfully a supervised 10 session training programme on ambulance dispatch and EMS protocols. Currently, local EMDs do not have an official protocol on OHCA recognition. From this study, the mean percentage recognition by EMDs of OHCA was found to be 67%. It is a known fact that the ability to recognize OHCA is a challenging task, but still the capacity to identify OHCA patients in Europe has been reported to be as high as 83%. [22, 24, 30] Moreover the mean percentage of telephone assisted CPR locally was found to be 58%. Kuisma *et al.*[30] showed that although bystander CPR in Finland was 71.3%, only 32.3% of OHCA patients in Finland were given tCPR. In another study from Seoul, South Korea, this number was 24.2%, with only 5.2% of the patients receiving CPR. [16] In another study in Taipei, Ma *et al.* [31] reported that about 33% of OHCA bystanders received tCPR instructions. Considering that at the time of writing local EMDs do not have an official algorithm or guideline on tCPR, this number is very encouraging and shows the awareness Maltese EMDs have on the benefits of tCPR. Various studies have shown that dispatchers are less likely to identify an OHCA if they do not ask about consciousness, do not confirm that a patient's breathing is normal[6, 19], or mistake agonal breathing sounds for normal respiration. [32] In this study, only 28% of EMDs who recognised OHCA asked about consciousness and normal breathing. Most of the EMDs could identify an OHCA by only asking whether the patient is breathing (66%). In contrast, when an OHCA was missed, only 8.5% of EMDs asked about consciousness and normal breathing but consistently a high number of EMD (51.5%) enquired about breathing only. Clegg *et al.*[33] analysed recordings from emergency calls and found that identification of breathing patterns was one of the most difficult and time consuming tasks during OHCA incidents. These results highlight the lack of a structured approach EMDs take when dealing with OHCA calls. The sole reliance on breathing questions especially when confronted with agonal breathing, which is notoriously difficult for lay people to explain, decreases significantly the recognition of OHCA. Successful recognition of OHCA is associated with an assessment of both the patient's consciousness and breathing pattern.[19,34-37]

Fukushima *et al.*[38] showed that laypersons describe agonal respiration in a wide variety of ways such as weak breathing, snoring and wheezing. Since the descriptions of agonal respirations are diverse, it is difficult for dispatchers to distinguish true cardiac arrest at emergency calls. Fukushima *et al.* [38] noted that while 84.2% (96/ 114 cases) of those who were described as 'not breathing' were identified as cardiac arrest and provided CPR instruction, only 27.8% (47/ 169 cases) of those with agonal respiration were identified as cardiac arrest. Along with other previous reports, many cardiac arrest victims with agonal respirations might lose the chance to receive CPR because of the misrecognition of cardiac arrest.[19-20] This is consistent with this study's reported results, with a higher recognition of OHCA (92%) in the unresponsive not breathing patient (Case 1 - 48/52), compared to OHCA recognition of 42% in a case of agonal breathing (Case 2 - 22/52). Other barriers to recognition of OHCA include the caller's description of signs of life, the type of caller, caller's emotional state and inadequate dialogue during the emergency call. In an analysis of emergency calls, Lewis *et al.* [39] found the factors that delayed dispatcher recognition of cardiac arrest were dispatcher-related (asking unnecessary or inappropriate questions), caller-related (emotional state, vague or misleading answers), and call-related (language barriers, time spent moving the patient). In addition, since victims not in cardiac arrest such as stroke can present with abnormal breathing, [40] there are concerns from EMDs about the risk of layperson CPR on non-cardiac arrest victims. [41] Recent studies have shown that the frequency of serious injury on non-cardiac arrest victims by CPR was very low.[42-43] A systematic review and pooled analysis done by Miller *et al.* [44] revealed that the incidence of CPR-associated major thoracic injuries such as aortic laceration, cardiac injury, pneumo/hemothorax or liver injury occur in up to 7 % of cardiac arrest victims. When it comes to unresponsive victims not in cardiac arrest, however, the risk of CPR was extremely low. Previous studies reported that chest compression for those not in cardiac arrest is much less hazardous resulting in chest discomfort or minor rib fractures.[43,45] Considering the high sensitivity and low specificity for abnormal breathing and low risk of chest compression for unresponsive persons not in cardiac arrest, it is suggested that EMS dispatchers can provide CPR instruction assertively and safely for those unresponsive cases with various abnormal breathing patterns described by laypersons.[46]

Recommendations

Our main recommendation is to provide educational programmes and training for dispatchers through protocols and simulation training focusing on communication challenges and identification of breathing patterns. Specific guidelines and algorithms should be made available for EMD use during 112 calls. Targeted simulation and education significantly increased recognition of OHCA and reduced time to first chest compression. In a study by Hardeland *et al.* 289 and 221 calls were included before and after targeted simulation and education respectively. Recognition of cardiac arrest improved from 74% to 89% ($p<0.001$), and delayed recognition was reduced from 14% to 5% ($p=0.001$). Agonal respiration continued to challenge dispatchers, but misinterpretation of abnormal breathing decreased from 25% to 8% ($p<0.001$) of calls. Median time to first chest compression was reduced by 30 seconds (204 vs. 174 seconds, respectively, $p=0,039$).[47] There is some evidence that a dispatcher's increased exposure to cardiac arrest calls can result in better outcomes for patients. Kuisma *et al.*[32] found an association between the frequency of cardiac arrest calls a dispatcher handled and patient survival rates. For dispatchers who handled fewer than four such calls during their study period, survival to hospital discharge was 22 %; by contrast, when dispatchers took more than nine calls, survival was 39 %.[13] It is plausible that additional opportunities to practice cardiac arrest call-taking, with targeted training on evaluating the need for tCPR, specifically, training on consistent querying of patient consciousness and breathing status, could improve dispatchers' ability to identify suspected cardiac arrest and decrease time to start of tCPR.

Conclusion

When compared to other European countries, OHCA recognition by Maltese EMDs needs to improve. However, given that the local EMDs have no formal guidelines or algorithms for their use during 112 calls, results are encouraging to say the least especially in telephone assisted CPR. With education and simulation training, these numbers

should improve.

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