Impact of the caller's emotional state and cooperation on out-of-hospital cardiac arrest recognition and dispatcher-assisted cardiopulmonary resuscitation

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ABSTRACT

Objective This study determined the impact of the caller's emotional state and cooperation on out-of-hospital cardiac arrest (OHCA) recognition and dispatcher-assisted cardiopulmonary resuscitation (DA-CPR) performance metrics.

Methods This was a retrospective study using data from November 2015 to October 2016 from the emergency medical service dispatching centre in northern Taiwan. Audio recordings of callers contacting the centre regarding adult patients with non-traumatic OHCA were reviewed. The reviewers assigned an emotional content and cooperation score (ECCS) to the callers. ECCS 1–3 callers were graded as cooperative and ECCS 4–5 callers as uncooperative and highly emotional. The relation between ECCS and OHCA recognition, time to key events and DA-CPR delivery were investigated.

Results Of the 367 cases, 336 (91.6%) callers were assigned ECCS 1–3 with a good inter-rater reliability (k=0.63). Dispatchers recognised OHCA in 251 (68.4%) cases. Compared with callers with ECCS 1, callers with ECCS 2 and 3 were more likely to give unambiguous responses about the patient's breathing status (adjusted OR (AOR)=2.6, 95% CI 1.1 to 6.4), leading to a significantly higher rate of OHCA recognition (AOR=2.3, 95% CI 1.1 to 5.0). Thirty-one callers were rated uncooperative (ECCS 4–5) but had shorter median times to OHCA recognition and chest compression (29 and 122 s, respectively) compared with the cooperative caller group (38 and 170 s, respectively). Nevertheless, those with ECCS 4–5 had a significantly lower DA-CPR delivery rate (54.2% vs 85.9%) due to 'caller refused' or 'overly distraught' factors.

Conclusions The caller's high emotional state is not a barrier to OHCA recognition by dispatchers but may prevent delivery of DA-CPR instruction. However, DA-CPR instruction followed by first chest compression is possible despite the caller's emotional state if dispatchers are able to skilfully reassure the emotional callers.

Key messages

What is already known on this subject?

- Dispatcher-assisted cardiopulmonary resuscitation (DA-CPR) increases the rate of bystander CPR, thereby improving the chances of survival for out-of-hospital cardiac arrest (OHCA) victims. Dispatchers ask two key questions about consciousness and breathing in order to identify OHCA over the phone.
- Previous studies have investigated barriers to OHCA recognition and found the caller's emotional state to be one of the influential factors.

What this study adds?

- In this review of 336 recorded calls to an emergency medical service dispatch centre in Taiwan, we found that the caller's high emotional state was not a barrier to OHCA recognition but may be a barrier to DA-CPR.
- Highly emotional callers who were reassured could execute first chest compression in a shorter time compared with the calmer callers.

INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) is both a significant prehospital issue and a global public health problem. In a systematic review and meta-analysis, Sasson *et al*[1] revealed that the rate of OHCA survival to hospital discharge is <8% and has not improved significantly for nearly 30 years, despite intense efforts invested in the field. Early recognition of OHCA and early provision of cardiopulmonary resuscitation (CPR) by a bystander can significantly increase the survival rate of OHCA.[2 3] However, the bystander CPR rate varies significantly from 10% to 65% in the USA,[4] 14.5% to 55.2% in England[5 6] and 10.5% to 40.9% in some Asian countries.[7] In Taiwan, the bystander CPR rate was around 17% in the metropolitan area in 2008.[8]

The emergency dispatcher plays a key role in helping callers recognise cardiac arrest and in providing instruction for chest compression-only CPR. Several studies have suggested that implementing dispatcher-assisted CPR (DA-CPR) in an emergency medical service (EMS) system is an effective strategy for increasing the frequency of bystander CPR, thereby improving the patient survival rate following OHCA.[9–11] However, when an emergency dispatcher attempts to recognise a

cardiac arrest and provide CPR instruction during an emergency call, some unpredictable factors may act as barriers (including the caller's spoken language, physical distance from the patient, emotional state and professional background).[12–14] These barriers may affect the caller's ability to perform effective CPR and start chest compression, but may also prolong the time to recognise the arrest or cause unsuccessful OHCA recognition by dispatchers, which decreases the OHCA survival rate.[15]

The callers' emotional state can affect interrogation success and assessment accuracy regarding the patient's condition.[14] A previous study conducted by Clawson *et al* examining callers' emotional content and cooperation score (ECCS) showed that most callers were calm and cooperative enough to be responsive to dispatchers' instructions during an emergency call.[16] Nevertheless, it is not known whether highly emotional or uncooperative callers could effectively respond to a structured interrogation and act on the DA-CPR instructions. The aim of our study was to examine the association between callers' ECCS and dispatchers' OHCA recognition and DA-CPR instruction performance.

MATERIALS AND METHODS

Setting

Hsinchu County is a suburban area in Northern Taiwan with approximately 542 000 people and population density of 380 people per square kilometre. There are 18 fire brigades with a single central dispatching centre located at the Fire Bureau of Hsinchu County. The central dispatching centre includes 10 dispatchers with an emergency medical technician-2 (EMT-2) certification or above, four registered nurses and two officers working on a rotational basis. There are approximately three dispatchers (one of them a registered nurse) working per shift. On receiving an emergency call, the nearest fire brigade is activated by the central dispatching centre to send at least one ambulance to the incident site (the ambulance service is part of the fire brigade). If a cardiac arrest is identified by the dispatcher during the emergency call, the fire brigade is informed of an OHCA on the scene before the ambulance is sent, and three board-certified EMTs are dispatched with the ambulance to provide basic or ALS care.

The comprehensive DA-CPR protocol[17] was implemented in Hsinchu County in November 2015 and consists of:

1. A 1-day training course for all dispatchers including didactic teaching and practical drills in different scenarios.
2. A standardised protocol for dispatchers which includes two key questions: 'Is the patient conscious?' and 'Is the patient breathing normally?' to determine whether the patient is in cardiac arrest, and CPR instruction to instruct callers on how to perform bystander CPR.
3. A monthly quality improvement meeting to debrief dispatchers on the quality of dispatchers' interrogation, successful recognition of cardiac arrest, successful DA-CPR delivery and reasons for failure to recognise cardiac arrest and provide CPR instruction.

Study design

This was a retrospective cross-sectional study examining audio recordings of documented OHCA obtained from the dispatch centres in Hsinchu County between November 2015 and October 2016.

Participant selection

The study cohort included callers who contacted the EMS dispatch centre for adult patients (age 18 years or greater) with non-traumatic OHCA during the study period. Cases were excluded if the audio recordings were missing, dispatchers did not have the opportunity to recognise cardiac arrest because the caller was not on the scene, the patient was reported to be conscious or breathing normally during the call, the calls were third-party or transfer calls or CPR was already in progress. For cases where the patient was reported to be conscious or breathing normally during the call, the arrests may have occurred after EMS arrival, in the ambulance or may have been wrongly judged by the callers, but due to difficulty of clarification these cases were also excluded.

Measurements

All sampled audio files were independently reviewed and evaluated by two reviewers (a registered nurse and an EMT paramedic) and verified by a medical director. Inter-rater reliability in ECCS assigning agreement was assessed. In cases of disagreement, all reviewers reached a final ECCS through discussion. The ECCS developed by the National Academy of Emergency Medical Dispatch was used to evaluate the emotion and cooperation of callers and consists of five levels: (1) normal conversational speech; (2) anxious but cooperative; (3) moderately upset but cooperative; (4) uncooperative, not listening, yelling and (5) uncontrollable, hysterical.[16] The callers' maximum ECCS levels were recorded and used for analysis. Before reviewing the audio files, the reviewers reached consensus on distinguishing between ECCS 2 and 3 or ECCS 4 and 5 by the caller's tone and speech. Callers were considered to have an ECCS level of 2 if their tone was sad or anxious, but an ECCS level of 3 if they sounded upset and were also crying and expressed their sadness or anxiety verbally. Callers were considered to have an ECCS level of 4 if their speech was comprehensible but they were yelling or acting distraught, and an ECCS level of 5 if their speech was incomprehensible.

Data collection

Demographic characteristics included caller's sex, relationship to the patient, ECCS level and spoken language. Time to key events included OHCA recognition by dispatcher, delivery of DA-CPR instruction and chest compression. Reasons for not providing DA-CPR instruction were also collected.

Outcomes

The primary outcomes were the rate of OHCA recognition, the rate of unambiguous caller responses about the patient's state of consciousness and breathing and the delivery rate of DA-CPR instruction (defined as the percentage of dispatchers who intended to deliver the instruction to the caller and entered into the DA-CPR instruction protocol) for each ECCS level. The ECCS levels were condensed into cooperative (ECCS 1–3) and non-cooperative (ECCS 4–5) to determine secondary outcomes of time to OHCA recognition, time to DA-CPR instruction delivery, time to chest compression and barriers to DA-CPR instruction delivery. OHCA was deemed to be successfully recognised by the dispatcher when the dispatcher verbally confirmed the patient was in cardiac arrest or attempted to proceed to DA-CPR procedure. The first chest compression was said to have commenced when the caller began to count compressions out loud, when other audible signs of CPR were heard (eg, rhythmic sounds made by the caller) or when the caller first verbally confirmed that compressions were being done.

Statistical analysis

Categorical variables are presented as numbers and percentages and compared using χ^2test or Fisher's exact test for caller's

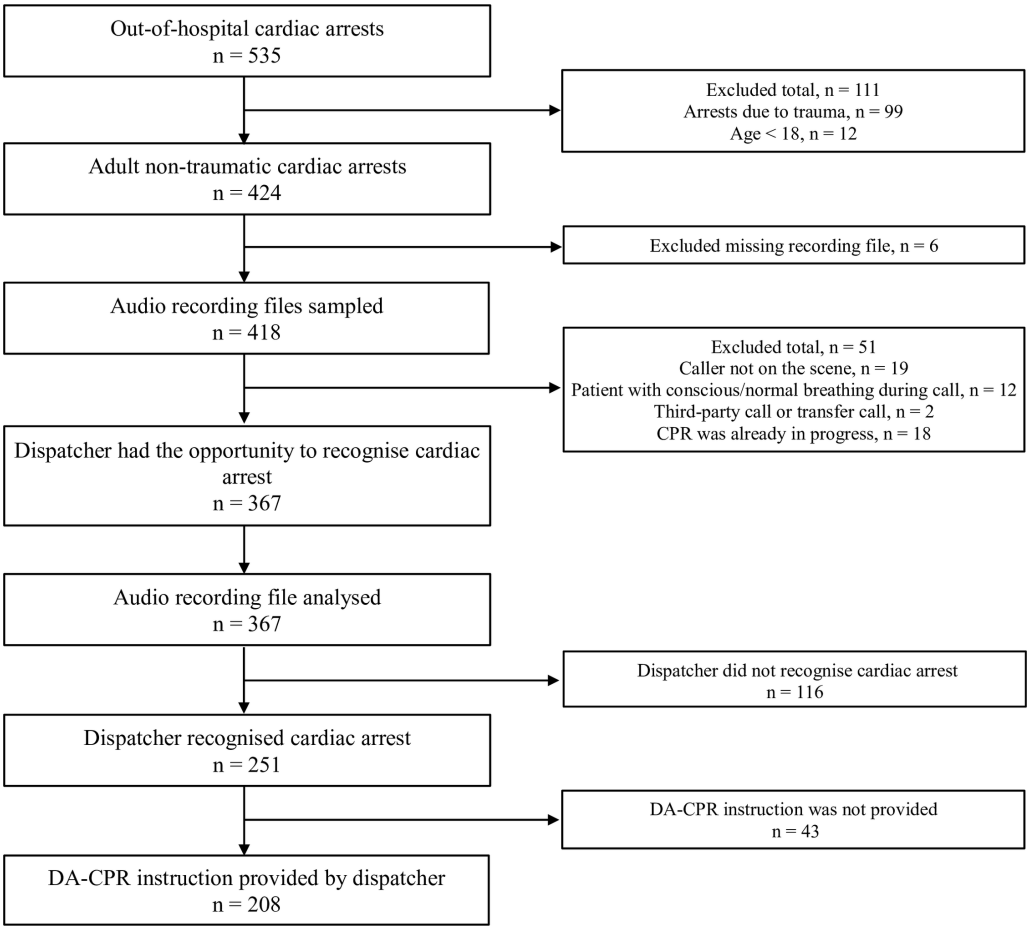

Figure 1 Flow diagram of case eligibility. DA-CPR, dispatcher-assisted cardiopulmonary resuscitation.

characteristics, OHCA recognition rate, the rate of unambiguous caller responses about the patient's state of consciousness and breathing, the delivery rate of DA-CPR instruction and barriers to DA-CPR, as appropriate. Continuous variables are presented as means and SD. The t-test and Mann-Whitney U test were used for normally and non-normally distributed continuous variables, respectively, to determine time to key events. Logistic regression was used to assess the relationship of ECCS to caller's unambiguous response to patient's breathing status or OHCA recognition. This analysis controlled for caller's sex and relationship with patient. Inter-rater reliability for assessing the agreement between the two reviewers in the ECCS assignment was conducted using a kappa statistic. A p value of <0.05 was considered to be statistically significant. The data were analysed using IBM SPSS Statistics (V.13.0 for Windows; SPSS, Chicago, Illinois, USA).

RESULTS

The case eligibility flow diagram is depicted in figure 1. There were 535 OHCA cases identified through EMS during the study period. Of these, 117 cases were excluded for trauma-induced OHCA, patient aged under 18 years or missing audio file. After reviewing the audio files, a further 51 cases were excluded when dispatchers did not have the opportunity to recognise a cardiac arrest during the call because the caller was not on the scene, the patient was reported to be conscious or breathing normally, the calls were third-party or transfer calls or CPR was already in progress. Ultimately, 367 cases were included for analysis.

Callers characteristics were as follows: 55.6% were female; 82.0% were a close relative (spouse, child or grandchild) of the patient; 96.7% were Mandarin speakers; 45% were calm (ECCS 1); 46.6% were anxious or moderately upset (ECCS 2 and 3); 8.4% were hysterical (ECCS 4 and 5) and 91.6% were considered to be cooperative (ECCS 1–3). More female callers (12.8%) were rated as ECCS 4–5 than male callers (3.1%). A good agreement ($k=0.63$) for ECCS assignment between the two reviewers was obtained for all eligible cases (table 1).

As shown in table 2, of the 367 cases, dispatchers recognised OHCA in 251 (68.4%) cases. Unambiguous responses about the patient's consciousness and breathing status were received in 343 (93.5%) and 281 (76.6%) cases, respectively. An unambiguous response for patient consciousness was similar across the ECCS levels (92.7%–95.7%), whereas the unambiguous response rate for patient breathing status was highest in the ECCS 3 (84.8%), followed by ECCS 2 (84.0%), ECCS 4–5 (77.4%) and ECCS 1 (68.5%) caller groups. The rate of OHCA recognition by dispatchers increased with ECCS level: ECCS 1 (61.8%), ECCS 2 (72.0%), ECCS 3 (76.1%), ECCS 4–5 (77.4%). Dispatcher error contributed mostly to the reason for non-recognition of OHCA in the low ECCS groups (ECCS 1: 73%, ECCS 2: 77%). Among the OHCA recognised cases, the rate of successful delivery of DA-CPR instruction in ECCS 1, ECCS 2, ECCS 3 and ECCS 4–5 groups were 85.3%, 84.4%, 91.4% and 54.5%, respectively. In multivariable analysis, dispatchers were significantly more likely to receive unambiguous responses about the patient's breathing status from callers classified as ECCS

Table 1 Characteristics of enrolled calls

Characteristics	
Caller's sex (n=367)	
Male, n (%)	163 (44.4)
Female, n (%)	204 (55.6)
Caller's relationship with the patient (n=367)	
Spouse, n (%)	117 (31.9)
Child, n (%)	113 (30.8)
Grandchild, n (%)	71 (19.3)
Friend, n (%)	25 (6.8)
Nursing staff, n (%)	22 (6.0)
Stranger, n (%)	16 (4.4)
Unknown, n (%)	3 (0.8)
Caller's language (n=367)	
Mandarin, n (%)	355 (96.7)
Taiwanese, n (%)	7 (1.9)
Hakka language, n (%)	4 (1.1)
Foreign language, n (%)	1 (0.3)
Caller's ECCS (n=367)	
1: Normal conversational speech, n (%)	165 (45.0)
2: Anxious but cooperative, n (%)	125 (34.1)
3: Moderately upset but cooperative, n (%)	46 (12.5)
4: Uncooperative, not listening, yelling, n (%)	28 (7.6)
5: Uncontrollable, hysterical, n (%)	3 (0.8)
Female caller's ECCS (n=204)	
1: Normal conversational speech, n (%)	86 (42.2)
2: Anxious but cooperative, n (%)	62 (30.4)
3: Moderately upset but cooperative, n (%)	30 (14.7)
4: Uncooperative, not listening, yelling, n (%)	24 (11.8)
5: Uncontrollable, hysterical, n (%)	2 (1.0)
Male caller's ECCS (n=163)	
1: Normal conversational speech, n (%)	79 (48.5)
2: Anxious but cooperative, n (%)	63 (38.6)
3: Moderately upset but cooperative, n (%)	16 (9.8)
4: Uncooperative, not listening, yelling, n (%)	4 (2.5)
5: Uncontrollable, hysterical, n (%)	1 (0.6)
Patient characteristics (n=367)	
Age, years, mean±SD	70.05±17.29
Male, n (%)	218 (59.4)
Female, n (%)	149 (40.6)

ECCS, emotional content and cooperation score.

Table 3 Adjusted OR AOR for ECCS

Characteristics	AOR (95% CI)*
Caller's unambiguous response to patient's breathing status	
ECCS 1	Reference group
ECCS 2	2.6 (1.4 to 4.7)
ECCS 3	2.6 (1.1 to 6.4)
ECCS 4–5	1.4 (0.6 to 3.4)
Recognition of cardiac arrest	
ECCS 1	Reference group
ECCS 2	1.6 (1.0 to 2.6)
ECCS 3	2.3 (1.1 to 5.0)
ECCS 4–5	2.2 (0.9 to 5.6)

*Adjusted for caller's sex and relationship with patient.
ECCS, emotional content and cooperation score.

2 (adjusted OR (AOR)=2.6, 95% CI 1.4 to 4.7) and ECCS 3 (AOR=2.6, 95% CI 1.1 to 6.4). Dispatcher OHCA recognition was significantly associated with the ECCS 3 group (AOR=2.3, 95% CI 1.1 to 5.0) (table 3).

Recordings for cooperative (ECCS 1–3) and uncooperative (ECCS 4–5) groups were compared for differences in patient's breathing status, time to key events and barriers to DA-CPR. As presented in table 4, there was a significant difference in the patient breathing status between groups. The cooperative caller group had a significantly higher successful delivery rate of DA-CPR instruction than the uncooperative caller group (85.9% vs 54.2%, p<0.01). The median times to OHCA recognition, CPR instruction and chest compression were 38.0, 80.5 and 170.0 s, respectively, in the cooperative caller group and 29.0, 91.5 and 122.0 s, respectively, in the uncooperative caller group. Overall, dispatchers failed to provide DA-CPR instruction in 43 of the 251 OHCA recognised cases with 'caller refused' (27.9%), 'hung up phone' (25.6%) and 'caller not near patient' (23.3%) being the top three reasons. 'Overly distraught' was one of the main barriers to DA-CPR instruction delivery in the uncooperative group.

DISCUSSION

The purpose of our study was to investigate whether a distraught and emotional caller could respond to a structured interrogation to aid in OHCA recognition and follow DA-CPR instruction. Our study found that most of the callers' emotions were manageable, with only 8.4% of the callers rated as ECCS 4–5:

Table 2 Performance of recognition by ECCS

Characteristics	Total n=367	ECCS 1 n=165	ECCS 2 n=125	ECCS 3 n=46	ECCS 4–5 n=31
Caller's unambiguous response to patient's consciousness, n (%)	343 (93.5)	153 (92.7)	117 (93.6)	44 (95.7)	29 (93.5)
Caller's unambiguous response to patient's breathing status, n (%)	281 (76.6)	113 (68.5)	105 (84.0)	39 (84.8)	24 (77.4)
Recognition of cardiac arrest, n (%)					
Yes	251 (68.4)	102 (61.8)	90 (72.0)	35 (76.1)	24 (77.4)
No	116 (31.6)	63 (38.2)	35 (28.0)	11 (23.9)	7 (22.6)
Delivery of DA-CPR instruction	n=251	n=102	n=90	n=35	n=24
Yes	208 (82.9)	87 (85.3)	76 (84.4)	32 (91.4)	13 (54.2)
No	43 (17.1)	15 (14.7)	14 (15.6)	3 (8.6)	11 (45.8)
Major reasons for non-recognition of cardiac arrest	n=116	n=63	n=35	n=11	n=7
Dispatcher non-adherence to protocol	81 (69.8)	46 (73.0)	27 (77.1)	5 (45.5)	3 (42.9)
Caller's ambiguous response	35 (30.2)	17 (27.0)	8 (22.9)	6 (54.5)	4 (57.1)

ECCS, emotional content and cooperation score.

Table 4 Comparison of patient's breathing status, performance of DA-CPR and barriers to DA-CPR between the cooperative and uncooperative groups

	Total	Cooperative (ECCS 1–3)	Uncooperative (ECCS 4–5)	P value
Patient's breathing status during emergency call	n=367	n=336	n=31	
Obvious no breathing, n (%)	227 (61.9)	203 (60.4)	24 (77.4)	<0.01
Probably agonal breathing, n (%)	89 (24.2)	89 (26.5)	0 (0)	
Not asked, n (%)	51 (13.9)	44 (13.1)	7 (22.6)	
DA-CPR performance metrics	n=251	n=227	n=24	
Successful DA-CPR instruction, n (%)	208 (82.9)	195 (85.9)	13 (54.2)	<0.01
Median time (IQR) to OHCA recognition, s	36.0 (20, 69)	38.0 (20, 69)	29.0 (18, 73)	0.58
Median time (IQR) to CPR instruction, s	81.5 (53, 119)	80.5 (53, 119)	91.5 (51.5, 116.5)	0.53
Median time (IQR) to chest compression, s	170.0 (113, 220)	170.0 (113, 220)	122 (115, 177.5)	0.26
Barriers to DA-CPR	n=43	n=32	n=11	
Hung up phone, n (%)	11 (25.6)	9 (28.1)	2 (18.2)	
Caller left phone, n (%)	1 (2.3)	1 (3.1)	0 (0)	
Caller refused, n (%)	12 (27.9)	8 (25.0)	4 (36.4)	
Caller not near patient, n (%)	10 (23.3)	10 (31.3)	0 (0)	
Patient's status changed, n (%)	1 (2.3)	1 (3.1)	0 (0)	
Overly distraught, n (%)	4 (9.3)	0 (0)	4 (36.4)	
Could not move patient, n (%)	4 (9.3)	3 (9.4)	1 (9.0)	

IQR (25%, 75%).
CPR, cardiopulmonary resuscitation; DA-CPR, dispatch-assisted cardiopulmonary resuscitation; EMT, emergency medical technician; OHCA, out-of-hospital cardiac arrest.

this is comparable to other studies.[16 18] OHCA was successfully recognised in most of the ECCS 4–5 caller cases and the rate of OHCA recognition was the greatest in the ECCS 4–5 group. These results suggest that a high ECCS level can be a preliminary clue for the dispatcher for recognising OHCA. An experienced dispatcher should be able to calm the caller and obtain relevant information for dispatching as well as provide the caller with needed information, such as DA-CPR instruction, in a timely fashion until emergency personnel arrive on the scene.[19] Nonetheless, a high ECCS level can greatly hinder the delivery of DA-CPR instruction. In our study, dispatchers could not offer DA-CPR instruction in 4 out of 11 (36.4%) ECCS 4–5 cases due to the caller being 'overly distraught'. 'Overly distraught' made up 9.3% of the overall barriers to DA-CPR instruction, which is in line with previous studies.[18 20–22]

In general, 'caller refused' and 'hung up phone' were the two most common barriers to DA-CPR in our study. Public education programmes or campaigns can address the most common reasons we found for not initiating DA-CPR. These should be implemented to address bystanders' concerns and improve their confidence in performing CPR. OHCA posters explaining what to expect during an emergency call can be posted in residential areas, schools or hospitals, to inform people about help they may receive during the call, such as DA-CPR instruction, so that they will know to stay on the line for instructions.

Overall, confirming patient breathing status was more difficult for the callers than confirming consciousness. The best unambiguous response to breathing was if the caller was in a middle range of emotion and the worst unambiguous response was in the calmest callers. Failure to recognise agonal breathing has been reported to impede dispatchers' ability to recognise OHCA. Agonal breathing can be described in a variety of ways and callers may mistake agonal breathing sounds for normal breathing during emergency calls.[23 24] In our study, nearly a quarter of the patients encountered by the ECCS 1–3 callers may have had agonal breathing. Nevertheless, through reviewing the audio recordings, we found that our dispatchers tended not to follow the protocol and did not ask about signs of agonal breathing or check the breathing pattern of the patient, thus causing failures to recognise OHCA that might have been avoided. Furthermore, we observed that dispatchers failed to recognise OHCA in 30 cases where an unambiguous response to the patient's breathing status was obtained—they overlooked breathing descriptions that were suggestive of agonal breathing (eg, slow breathing, little breath) and judged incorrectly. To improve recognition of OHCA, dispatcher training in breathing assessment, identifying the terms often used by laypersons to refer to agonal breathing and protocol compliance should be enhanced.

ECCS 4–5 caller group had a shorter median time to OHCA recognition (9 s less), longer median time to DA-CPR instruction delivery (11 s more) and a shorter median time to first chest compression (48 s less) than the ECCS 1–3 caller group. It is possible that the ECCS 4–5 callers were more distraught because they recognised that the victim was unresponsive and not breathing, this may have allowed the dispatcher to recognise OHCA in a shorter time. However, as these callers were highly emotional and distraught, more time was needed to reassure them and calm them down, delaying the time to DA-CPR instruction. However, once reassured, the callers commenced the first chest compression quickly in the hope of saving the patient's life.

Limitations

This study has several limitations. First, it was a retrospective study using data from a single city in northern Taiwan; therefore, it may not be representative of the wider OHCA population. Second, statistical bias may have been introduced by the small sample size, limited local population and selection bias. Third, six cases were excluded because the audio files were missing. Fourth, there were technical difficulties in objectively evaluating the caller's ECCS, although we reached consensus on the ECCS assignment before reviewing the audio recording files, and the inter-rater reliability was good. Fifth, the number of probable

agonal breathing cases was a subjective judgement by researchers which may have deviated from actual cases. Sixth, female callers were more likely to be rated as hysterical than the male callers. While the reviewers were of both sexes, this could be a result of the fact that term 'hysterical' is more readily applied to women than men, potentially by either sex. Therefore, the present study results should be considered hypothesis-generating and verified by further investigations.

CONCLUSION

Distraught callers made up only a small proportion of the overall number of callers and were not a barrier to OHCA recognition. Although the rate of DA-CPR was lower in more emotional callers, once reassured, they were able to follow DA-CPR instruction and performed the first chest compression in a shorter time than the less emotional callers. Public education is likely to help improve the number of callers who remain on the phone and are willing to perform DA-CPR.

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