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Recognizing Sudden Cardiac Arrest May Require More Than Two Questions during Telephone Triage: Developing a Complementary Checklist

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ABSTRACT

Objective: To develop decision-support tools to identify patients experiencing sudden cardiac arrest (SCA).
Methods: Eighty calls related to SCA were content analyzed, and the contextual patterns that emerged were organized into a checklist. Two researchers independently analyzed the recorded calls and compared their findings. Eighteen dispatchers scored 20 cases (which included SCA and non-SCA cases) both with and without the checklist. Correct responses for each case and agreement among dispatchers have been reported.
Results: Eighty audio files (total time, 96 min) were analyzed, and a total of 602 codes were extracted from the text and recordings. The caller's tone of voice and presence or absence of background voices, calling for an ambulance and giving the dispatcher the address promptly, and description of the primary complaint and respirations accounted for 38%, 39%, and 23% of all codes, respectively. A 15-item complementary checklist has been developed. The mean percentages of correct responses were 66.9%±27.96% prior to the use of checklist and 80.05%±10.84% afterwards. Results of the independent *t* test for checklist scores showed that statistically significant differences were present between the SCA and non-SCA cases (t=5.88, df=18, *p*=0.000).
Conclusion: Decision support tools can potentially increase the recognition rate of SCA cases, and therefore produce a higher rate of dispatcher-directed CPR.

Keywords: Decision support tool; Cardiac arrest; Telephone triage; Emergency medical services.

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Introduction

The time interval from collapse to chest compressions is the first ring in the chain of survival, so bystanders as well as dispatchers have unique roles in an emergency medical system [1, 2]. Dispatchers must recognize the symptoms of high-risk situations such as sudden cardiac arrest

(SCA) or stroke [3]. Decisions concerning CPR and its initiation are usually made under conditions of uncertainty, because an adequate method to verify the signs and symptoms reported by bystanders is not available for dispatchers. In addition, callers are under tremendous pressure to provide accurate information about their patients as well as recognize confusing signs such as agonal breathing, so the inability to recognize cardiac arrest by both dispatchers and bystanders has been reported [2]. Compared to hospital triage, triage guidelines have shown substantial agreement in the emergency department [4-7].

It's worth mentioning that a telephone triage protocol for unresponsive people is rare and the sensitivity and specificity for signs or symptoms also varies significantly, compromising their diagnostic value [3]. However, serious obstacles exist to the development of telephone triage, and promoting the practice of evidence-based medicine is vital to guarantee accurate recognition of critically ill patients. Therefore, it is pivotal to develop a triage protocol to facilitate prompt identification of patients with SCA. Furthermore, ambulance response time often exceeds the "golden time" needed to resuscitate unresponsive patients [2]. Under such circumstances, great demands are made with respect to the clinical applicability of a decision support tool.

Hardeland *et al*. compared medical dispatch tools in managing cardiac arrest calls, including Medical Priority Dispatch (MPD) and Criteria-Based Dispatch (CBD). The results of their comparison showed that, regardless of which medical dispatch tools are more effective, decision support tools must be used to provide faster pre-arrival CPR by a lay rescuer [2]. The American Heart Association (AHA) has stated that two questions must be asked by laypersons to dispatchers when deciding whether to perform CPR, including "Is the patient responsive/ conscious?" and "Is the patient breathing normally?" [8]. Generally, other tools were based on these two questions, but several studies have indicated that these questions have led to deep discrepancies in how and when CPR is performed in routine practice.

Decision support tools must clearly assist dispatchers to start CPR-directed instructions for bystanders, so pre-arrival CPR indications vary among protocols [2, 9]. In a few studies, the indication for the performance of CPR was defined as unconsciousness and not breathing normally according to the caller description [9, 10]. Breathing recognition and giving CPR instructions take considerable time during emergency calls [11], showing the importance of breathing during call processing by dispatchers and laypersons [11]. It's been suggested that the agonal breathing that often occurs during the first early moments of SCA may limit the ability of dispatchers to start directed CPR [12, 13]. The survival rate in those with agonal breathing is 27%, while it declines 9% for those without agonal breathing [14]. In spite of the fact that no scientifically proven methods have been developed yet to help callers and dispatchers precisely recognize agonal gasping, the concept of "not normally breathing" associated with sudden cardiac arrest may be assumed to refer to "not breathing" or to "agonal gasping" in the unconscious patient, so cardiac compressions must be performed [8]. In light of this, the ability of dispatchers to precisely identify SCA is varied between 14% and 90%, suggesting that decision support tools must be significantly developed [12, 15]. In addition, 4.3% of emergency callers have been mistakenly directed to perform CPR by dispatchers [16].

It is important to note that most people have not been trained to be rescuers or to resuscitate someone, so dispatcher directions may fill the gap. Several studies have developed CPR telephone protocols to help dispatcher's direct bystanders in EMS [1, 9]. The CPR telephone protocol must be capable of providing a simple and effective method for directing bystanders that results in prompt chest compressions. Dispatcher instructions increase chest compressions [1, 13], but it remains controversial whether there is a positive effect on neurologically favorable outcomes [14, 17, 18], so dispatch-directed CPR is still assumed to be a reasonable procedure or part of a rescue protocol. Few studies have developed decision support tools, and various discrepancies remain unresolved with respect to assisting in response to situations involving SCA and its identification. Accordingly, our aim was to develop a decision support tool to identify patients with SCA.

Materials and Methods

Study Design

A 2-phase study was conducted at the Emergency Medical Dispatch Center in Mashhad University of Medical Sciences. Checklist development has been performed to investigate core categories and associated items in phase I. During a pre and post assessments, emerged categories and items were validated by dispatch nurses in phase II.

Participants and Setting

The Emergency Medical Dispatch Center receives more than 5000 emergency calls daily from within the city limits of Mashhad, Iran, which is located in the north-east of Iran and has a population of 3 million. Ten dispatchers receive emergency calls during each shift. Dispatchers have a Bachelor of Science in Nursing and at least two years of work experience in Emergency Medical Services. Additionally, these dispatchers regularly participate in annual training courses on telephone triage. Following approval from the University`s ethics committee, informed consent was obtained from each of the telephone triage nurses participating in the study. Calls were fully analyzed by researchers in the dispatch center to provide optimal data security in order to prevent the removal of audio files from the database.

Checklist Development

All emergency calls are recorded in the dispatch center. During the period from April 1 to June 1, 2015, the last 80 calls confirmed as SCA were collected. Calls that did not product significant and meaningful conversation were excluded. Audio files were transcribed verbatim and analyzed using Sound Forge™ Audio Studio software (Version: 10.0). The word-for-word transcriptions were coded using Hsieh and Shannon`s conventional content analysis, and researchers began by identifying key concepts as initial coding categories [19]. Researchers initially read the transcript and proposed three main categories to further in-depth analysis. These three categories were callers' tone and presence of background voices, calling for an ambulance and providing an address, and description of the patient's primary complaint and respiration status. The initial analysis primarily concerned itself with verbal context (e.g., background voices, tone of voice, and calling for an ambulance) and verbal content (e.g., description of primary complaint). Data were coded into predetermined categories by listening to the audio files and reading them back verbatim. Two researchers (A.M. and H.Sh.) independently analyzed the recordings and compared their findings; code frequencies were also documented, and any disagreements were discussed and resolved by consensus. Finally, a 20-item complementary checklist was developed to facilitate recognition of patients with SCA (Table 1).

Checklist Validation

The first phase of the simulation occurred when dispatchers were asked to triage 20 recorded audio files. All dispatchers were invited to take part in the study; 18 agreed to participate. Exclusion criteria were based on keeping the originality of evaluation, so dispatchers were excluded in cases of talking during the exam. Cases were randomly selected from the database. Twenty cases were randomly divided into 10 cases with SCA and 10 cases without SCA (SCA and non-SCA groups). In the following, the complementary checklist has been introduced to dispatchers and they were asked to triage the same 20 recorded audio files again using the complementary checklist. Relevant items in the checklist had to be checked off if applicable to the recordings. They scored one point per each item selected in the checklist while listening to the recordings, so each dispatcher`s score had the potential for a maximum score of 20. Dispatchers were not allowed to consult each other and to be informed of true responses until the end of study. In fact, they were asked to categorize each case as SCA or non-SCA. SCA cases were defined as patients with SCA who needed dispatcher-directed CPR.

Statistical Analysis

Descriptive and inferential statistics were used. Descriptive statistics were used to describe means, standard deviations, and frequencies. The independent *t* test was used to compare dispatchers` scores between the SCA (n=10) and non-SCA groups (n=10). Kappa statistics were employed to examine agreement between dispatchers. All statistical analysis was performed using SPSS, version 16.0 (IBM, Armonk, New York, USA).

Results

Eighty audio files related to patients with SCA were analyzed. The separate recordings among the total recording time of 96 min ranged between 20 and 287 seconds in length, with a median time of 75 seconds.

Table 1. Items of supplementary checklist for recognition of patients with sudden cardiac arrest (N=80).

Items	Frequency (%)	Items	Frequency (%)
Callers' tone and background voices		**Description of primary complaint and respiration**	
Rapid speech	67 (84)	Patients having emergency conditions	15 (19)[a]
Worried and afraid	58 (73)	General Condition (Consciousness)	
Buzz in background	53 (66)	Collapsed	22 (28)
Shallow panting	25 (31)	Extremely feeling unwell	13 (16)[a]
Crying in background	14 (18)	Feeling unwell	12 (15)[a]
Callers` crying	10 (13)	Passed out	11 (14)
Calling an ambulance and providing an address/information		Not awaked	6 (8)[a]
Lack of concentration during conversations	44 (55)	Swooned	4 (5)[a]
Asking for an ambulance prior to relaying the primary complaint	40 (50)	Breathing	
Asking for an ambulance highly emergency	40 (50)	Breath does not come up	25 (31)
Repeated calls to request an ambulance	40 (50)[a]	Difficulty in breathing	14 (18)[a]
Did not pay attention to questions	28 (35)	Turning black or blue	13 (16)[a]
Asking for ambulance without relating the address	28 (35)	Snoring	5 (6)[a]
Inability to follow the dispatcher`s commands	14 (18)	Seems to be choking	1 (1)[a]

[a]Item was removed from the checklist in the second phase of study.

Four calls were excluded from the study due to the absence of significant, meaningful conversation. Sixty percent of callers were male. Six hundred and two codes were extracted from text and recordings. Callers' tone and background voices, calling for an ambulance and providing an address, and description of primary complaint and respiratory status have accounted for 38%, 39%, and 23% of all codes, respectively. Items and frequencies that have been extracted during content analysis of recordings are presented in Table 1. A checklist with 25 items has been developed.

Eighteen female dispatchers participated in the study with age and work experience of 31.31±3.35 and 4.21±2.25 years, respectively. All of them had previously taken part in telephone triage training programs. None of them was excluded from study. The mean (SD) percentages of correct responses were 66.9%±27.96% prior to the use of checklist and 80.05%±10.84% afterwards). Dispatchers had correctly identified 68% and 66% of SCA and non-SCA cases; the use of the checklist increased this accuracy to 84% and 76%, respectively. The un-weighted kappa coefficient was slight before checklist (K=0.22±0.15, CI 95% 0.7-0.37) and was increased while dispatchers were helped by the checklist (K=0.37±0.11, CI 95% 0.14-0.59).

Ten out of 25 items that did not remarkably contribute to the SCA group were removed from the preliminary checklist. These items included: asking for an ambulance without providing an address, repeated ambulance request calls, having an emergency condition, feeling extremely unwell, feeling unwell, not able to be awakened, swooned, turning black or blue, snoring, and seeming to be choking. Only 15 items remained in the checklist after the elimination of these items (Figure 1).

The Shapiro–Wilk test for normality showed that scores did not significantly differ from a normal distribution (*p*-value is 0.48). The mean scores for SCA and non-SCA cases were 70.20±14.60 and 30.40±15.61, respectively (Figure 2). Results of the independent *t* test for checklist scores showed that there was a statistically significant difference between the SCA and non-SCA cases (t=5.88, df=18, *p*=0.000).

Discussion

The recognition of patients with SCA has been improved by the use of a complementary checklist as a part of telephone triage. Currently, telephone triage suffers extensively from limited guidelines to support evidence-based practice, so decision support tools can play an important role to maximize decision accuracy in practice [3, 13]. This study shows that SCA patients were identified in 84% of cases by dispatchers, congruent with 80% of reviewed cases that had been reported by Lewis *et al*., [1]. These researchers had also asserted that the identification rate could be increased to 92% of cases if they were able to assess patient consciousness and breathing [1]. Assuming an average rate of 70% [18], the rate of recognition in the detection of cardiac arrest by dispatchers over the telephone ranged from 47% to 97% [13]. Extensive variations in rate may suggest that contextual cues play a more important role than what was previously assumed. In addition, standard protocols commonly had lower sensitivity than did locally-adapted protocols covering socio-cultural issues [20].

The present findings showed that dispatchers significantly scored higher on patients with SCA than patients with non-SCA by the use of complementary checklist as well as by making more accurate decisions while they used a 15-item checklist (Figure

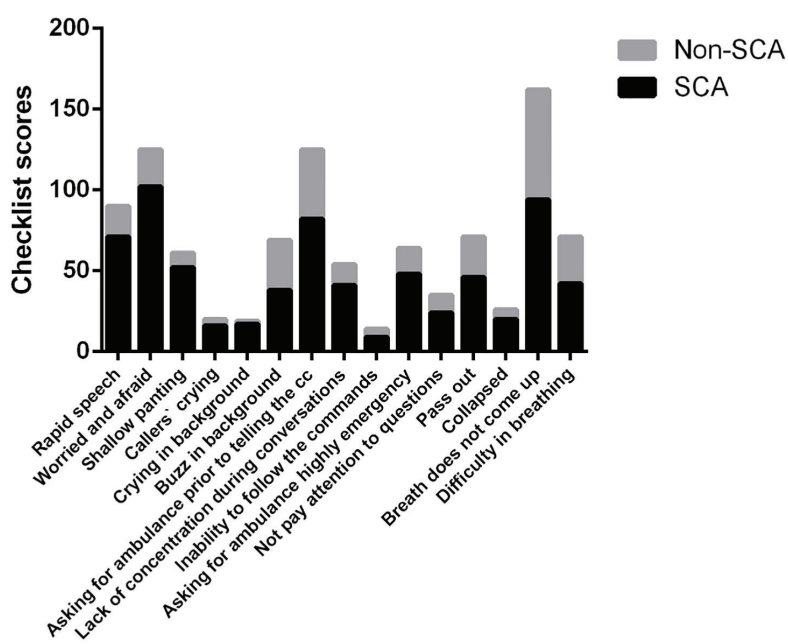

Fig. 1. Comparison of item scores between SCA and non-SCA cases

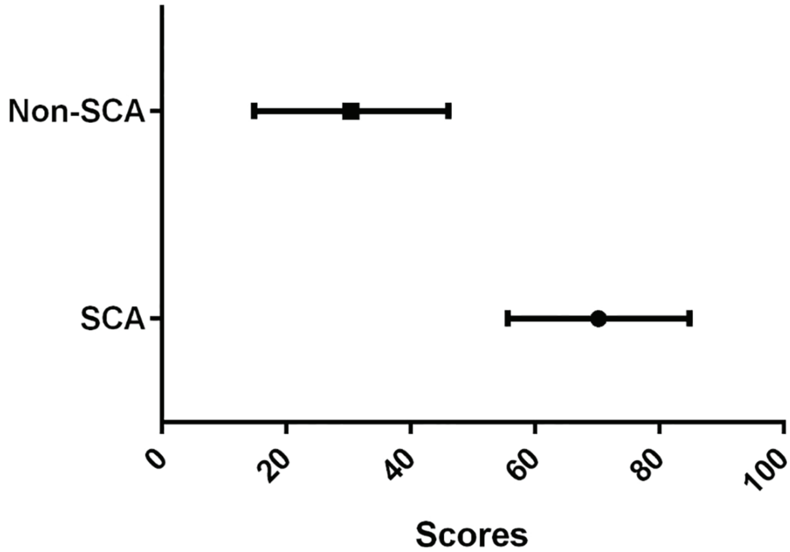

Fig. 2. Comparison of mean checklist scores between SCA and non-SCA cases

1). However, the American Heart Association (AHA) scientific statement indicated that dispatch CPR pre-arrival instructions are based on a 2-question approach, which includes "Is the patient responsive?" and "Is the patient breathing normally?"; no single identification strategy covers all SCAs [1]. Other contextual patterns may assist the dispatcher and help increase the reliability of their decisions [20]. It seems necessary that dispatchers do not neglect the significance of contextual patterns. Contextual factors may also depend on cultural rule in every society, so further research to develop culturally adapted checklists is suggested.

In congruence with the current findings, Tanaka *et al*. showed that some keywords could be associated with callers' description of their primary complaint relating to SCA patients. The frequency of specific location, chest pain, and past medical history was significantly higher for the SCA cases. On the contrary, the frequency of onset while eating, abnormal movements or convulsions, and syncope or dizziness was significantly lower for the SCA patients [20]. We found that repeated calls for a wide variety of medical emergency situations, including requesting an ambulance, patients having an emergency condition, patients feeling extremely unwell or unwell, not awakening, having swooned, for difficulty in breathing, turning black or blue, snoring, seeming to choke, or repeated calls for requesting an ambulance, have not significantly contributed to the recognition of SCA patients (Table 1). In whatever way keywords could have originated from culturally dependent patterns, ultimately contextual cues must be considered in decision support tools.

Content analysis indicated that contextual patterns in dispatcher–caller interactions have the potential to help dispatchers accurately recognize SCA patients. Callers with SCA patients showed recurrent patterns in conversation with dispatchers in relation with the effect of emergency situation on bystanders and callers arising from extreme emotional distress. Seventy-seven percent of codes were related to contextual patterns, suggesting that considerable information exists in the added context that might surface with a 2-question approach (or using more questions or through longer interaction) through telephone triage interaction. In this way, eight out of ten items removed from the preliminary 25-item checklist were associated with consciousness and breathing, implying that there is substantial discrepancy between caller and dispatcher in relation to correct recognition of signs and symptoms of SCA patients [13].

Multiple studies have addressed the recognition gap with respect to SCA patients in telephone triage [12, 15]. Agonal breathing has been introduced as a well-known barrier to recognizing SCA patients [1, 10]. Bystanders in many instances may not be able to distinguish normal from abnormal breathing, resulting in delays in dispatcher-directed CPR and rescue efforts [1]. These findings lead to the conclusion that ongoing training may be helpful to dispatchers to detect agonal respirations during cardiac arrest. Decision support tools are effective educational tools for in-service and ongoing training.

Current findings showed that dispatchers must be aware of the fact that bystanders often use emergency expressions in both emergency and urgent conditions, so it may be helpful for dispatchers to give appropriate weight to contextual patterns stemming from the emotional distress embedded in emergency situations.

Agreement was slight among dispatchers, and inter-rater agreement is far from substantial in hospital triage [4]. Although it's expected that hospital triage shows higher agreement than telephone triage, and face-to-face observation is a great help for triage nurses who identify critically ill patients, the reliability of telephone triage needs to be extensively investigated. Decision support tools can increase the reliability of dispatchers' decisions, especially if they are further developed. In addition, dispatchers have limited access to patients' signs as well as to diagnostic tools, so it's pivotal that everything possible be extracted and analyzed from caller-dispatcher interaction, especially non-verbal cues.

One limitation of the study was related to recorded cases. Dispatchers listened to the recordings and decided on patient acuity, so they didn't have a chance to explore cases in-depth. Studies indicated that it could not be determined which triage setting provides a more accurate triage score, while paper case scenarios generally receive lower triage scores than live cases. It's suggested that complementary checklist will be examined in real-life clinical practice.

Decision support tools are vital to recognize patients with sudden cardiac arrest over telephone. Tools have the potential to increase the recognition rate of SCA cases, leading to a higher rate of dispatcher-directed CPR. Extreme emotional distress provides unique impact on the scene that is very helpful to dispatchers. Therefore, contextual cues must not be neglected by dispatchers while considering that callers` failure to recognizing SCA patients is serious.

Conflict of Interest: None declared.

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