RESUSCITATION 139 (2019) 144–151

Available online at www.sciencedirect.com

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

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Clinical paper

Dispatcher-assisted cardiopulmonary resuscitation for paediatric out-of-hospital cardiac arrest: A structured evaluation of communication issues using the SACCIA® safe communication typology

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https://doi.org/10.1016/j.resuscitation.2019.04.009
Received 25 January 2019; Received in revised form 18 March 2019; Accepted 3 April 2019
Available online xxx

Abstract

Aim: To evaluate communication issues during dispatcher-assisted cardiopulmonary resuscitation (DACPR) for paediatric out-of-hospital cardiac arrest in a structured manner to facilitate recommendations for training improvement.

Methods: A retrospective observational study evaluated DACPR communication issues using the SACCIA® Safe Communication typology (Sufficiency, Accuracy, Clarity, Contextualization, Interpersonal Adaptation). Telephone recordings of 31 cases were transcribed verbatim and analysed with respect to encoding, decoding and transactional communication issues.

Results: Sixty SACCIA communication issues were observed in the 31 cases, averaging 1.9 issues per case. A majority of the issues were related to sufficiency (35%) and accuracy (35%) of communication between dispatcher and caller. Situation specific guideline application was observed in CPR practice, (co)counting and methods of compressions.

Conclusion: This structured evaluation identified specific issues in paediatric DACPR communication. Our training recommendations focus on situation and language specific guideline application and moving beyond verbal communication by utilizing the smart phone's functions. Prospective efforts are necessary to follow-up its translation into better paediatric DACPR outcomes.

Keywords: Cardiac arrest, Cardiopulmonary resuscitation, SACCIA, Safety, Communication, Dispatcher-assisted, Paediatric

Introduction

The outcome of paediatric out-of-hospital cardiac arrest (OHCA) is dismal with survival rates ranging from 3 to 17%.[1,2] Early commencement of cardiopulmonary resuscitation (CPR) by bystanders for paediatric OHCA has been shown to improve overall and neurologically favourable survival.[3–5] However, the performance of bystander CPR in paediatric OHCA (vs. non-performance) has been variable across different countries, ranging from 23% in Singapore to 35% in North America and 53% in Japan.[4–7] Dispatcher-assisted CPR (DACPR) is an effective strategy which has been shown to increase the performance of bystander CPR and also survival from OHCA.[4,5,8–10] When a caller activates Emergency Medical Service (EMS), in addition to dispatching ambulance to scene, the dispatcher, as the first professional contact for cardiac arrest, is able to aid the recognition of cardiac arrest by eliciting key information and provide guidance to the caller. A simple, two-question algorithm (Fig. 1) is used so that the first chest compression is delivered within seconds of the call for help.[8] Callers are instructed to put the phone on speaker mode to facilitate DACPR instruction.

In Singapore, an adult DACPR protocol was introduced in 2009 and the bystander CPR rates increased from 19.7% to 22.4% from 2009 to 2012.[11] Subsequently, a DACPR bundle consisting of DACPR protocol for adult and paediatric OHCA, dispatcher training, systematic quality improvement through review of all dispatch calls, and public education campaign around DACPR, were implemented under the Pan-Asian Resuscitation Outcomes Study (PAROS) II, equipping and empowering all dispatchers to provide DACPR.[12,13] However, execution of DACPR is operationally challenging. In an earlier study, barriers which delayed and prevented successful compressions were identified.[14] Amongst the list of communication barriers, 'Caller overly distraught', 'Language', 'Quality of instructions' and 'Technical difficulties' were reported challenges related to the provision of DACPR. Other barriers were related to the use of the phone, the location of the caller and the position of the patient.[14]

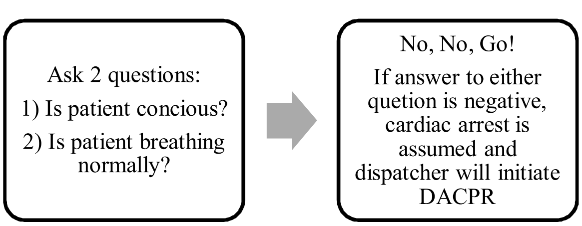

Fig. 1 – Algorithm for recognition of cardiac arrest by EMS dispatcher.

Paediatric DACPR communication is inherently challenging because it requires identification of paediatric arrest over the phone and the provision of complex verbal CPR instructions (i.e. chest compressions with ventilation as compared to adoption of hands-only CPR instructions for adults). As remote instructions are given, the dispatcher has minimal feedback on the actual delivery and quality of the rescuer's CPR rendered to the victims. Little is known about the factors facilitating and hindering communication during DACPR in both adult and paediatric populations. Given its complexity, we hypothesize that common communication errors occur in paediatric DACPR. To inform this hypothesis, we need a systematic examination of the interpersonal communication in the context of DACPR to identify issues that affect transmission, receipt, translation and feedback during the process.

In this study, we aim to evaluate communication issues during DACPR for paediatric out-of-hospital cardiac arrest to facilitate recommendations for training improvement using a novel evidence-based categorization scheme for safe healthcare communication.[15]

Methods

Setting

In Singapore, a dense multi-ethnic city state of 5.6 million inhabitants,[16] EMS is primarily provided by the Singapore Civil Defence Force (SCDF), with a minority of private ambulance operators. SCDF, which is the national Fire, Rescue and Emergency Medical Response Agency, dispatches ambulances and first-responder motorcycles in response to medical calls. Activation of EMS is by calling 995 to a centralized dispatch centre, which utilizes computer aided dispatch protocols (using the PowerPhone system which allows modification to existing protocols and supports the 'no, no, go' methodology), a global position satellite automatic vehicle location system and road traffic monitoring systems to optimise operations. This service is free to all emergency callers and supported through government taxes. SCDF employs dispatchers who are all trained in DACPR. In addition, nurses are employed to run quality assurance and improvement programs, as well

1) Bring the phone next to patient
2) Put the phone on speaker mode
3) Position patient and airway, remove foreign body with little finger (if any)
4) Locate landmark for chest compressions
- Infant: Place middle and ringer fingers on the centre of chest
- Child: Place one hand on the centre of the chest, right between the nipples
5) Instruction for chest compressions
- Infant: Push down 4cm, pump hard and fast for 30 times
- Child: Push down 5cm, pump hard and fast for 30 times
6) Counting chest compressions
- Count 1,2,3,4,5,6,7,8,9,10;2,2,3,4,5,6,7,8,9;10,3,2…
7) Instruction for ventilations*
- Infant: Tightly patient's cover mouth and nose with your mouth and give 2 quick breaths, chest rise as you blow
- Child: Pinch nose and cover patient's mouth with your mouth and give 2 quick breaths
8) Continue compressions and ventilations
- Continue to give 30 pumps then 2 breaths for 5 rounds
9) Provide reassurance
10) Arrival of ambulance
Optional:
11) Check for normal breathing
12) What to do when the patient vomits
13) Put the patient in recovery position
14) What to do if a second rescuer is available
15) Situational control

*Chest compression only CPR is provided. Convention CPR will only be provided for paediatric or drowning cases at 30 compression: 2 ventilations.

Fig. 2 – Instruction template for DACPR.

as to provide additional nursing advice when necessary. The DACPR instruction template is described in Fig. 2.

Study population and design

We conducted a retrospective observational study. Cases of pediatric cardiac arrest were retrieved from a registry under PAROS, which included all cases of OHCA identified by the paramedic on scene. Data was collected from ambulance records and audio files with the two-way telephone recordings of the DACPR performance between dispatcher and caller using standardized forms for all paediatric OHCA cases handled by the SCDF dispatch centre from 1 January 2014 to 31 December 2015. Paediatric cases were defined by age 16 years or less. Data fields pertaining to demographics, instruction and performance of DACPR, as well as clinical course and outcomes were collected.

Theoretical framework

We used the SACCIA® Typology of Safe Communication in Healthcare a recent first evidence-based categorization scheme for safe healthcare communication that lends itself for analysing communication issues in paediatric DACPR situations.[15] According to the SACCIA framework, safe and high-quality DACPR communication encompasses "all verbal and non-verbal behaviours that, through adequate quantity and quality, optimize the likelihood of delivering the most appropriate and effective outcomes".[15] The letters in the acronym "SACCIA" stand for five common types of communication errors: Sufficiency, Accuracy, Clarity, Contextualization and Interpersonal Adaptation.[15] These errors transpire across three communication processes: during DACPR, the caller and dispatcher (1) encode their own thoughts, feelings and intentions into words and actions,

Table 1 – SACCIA® principles for safe communication.[17]

Principle	Implication
Communication is contextual	Meaning of a message is always influenced by the context in which interaction takes place.
Redundancy in content and directness in channel enhance accuracy	Likelihood of attaining shared understanding increases when care participants repeat message content appropriately through direct rather than indirect means.
Communication is a non-summative process	Communication is an interactive process whose goal in healthcare is to reach a state of shared understanding.
Preconceptions and perceptions vary among communicators	Care participants enter any given care episode with different preconceptions and will perceive their communication differently.
Communication entails factual and relational information	Communication always conveys both factual and relational information.
Communication varies between thought, symbol and referent	Humans 'make meaning' through the creation and use of symbols (e.g. words, gestures, sounds).
Communication is more than words	Verbal messages are always accompanied by nonverbal behaviours or expressions that include visible and vocal cues.

(2) decode received messages in an effort to replicate the sender's intended thoughts, feelings, or intentions and (3) engage in transactional (i.e. dyadic) communication to jointly generate a shared understanding.[15] Beyond identifying communication errors, the SACCIA framework further allows for an evidence-based root cause analysis that traces the reasons for such errors to seven common misassumptions about human communication.[17] These seven "SACCIA root cause principles" are defined and summarized in Table 1.

Data management and analysis

Four researchers independently identified and scored the communication issues from the audio files. AFH, an expert in communication sciences and co-founder of the SACCIA® framework, has trained the other three researchers who have a background in emergency medicine (JHP, GO) and health services research (DFK). Recordings of the audio files were played back in a dedicated control room on SCDF premise by SCDF staff. Researchers noted down the communications verbatim and classified the issues raised accordingly to the SACCIA® Typology. Differences in classification were discussed and an overall agreed scoring plot was analysed as there could be overlap between the communication error categories. The seven SACCIA principles of communication were used for root cause analysis. SCDF's DACPR experts reviewed and commented on the different drafts.

This study received ethical approval and was granted a waiver of patient consent (CIRB 2013/604/C and DSRB 2013/00939).

Results

Cohort characteristics

There were 51 paediatric OHCAs in the study period. Available audio files were retrieved and matched 31 (61%) cases. DACPR was initiated in 15 (48%) cases. The remaining cases did not receive DACPR due to ongoing bystander CPR at time of call (n = 10), caller not at scene (n = 4) and patient not in cardiac arrest at time of call (n = 2). Of the 15 cases with DACPR, 12 (80%) translated into actual performance of DACPR by the caller. One caller did not perform despite instruction. For the other 2 cases, the ambulance arrived prior to commencement of CPR by the caller (see Fig. 3).

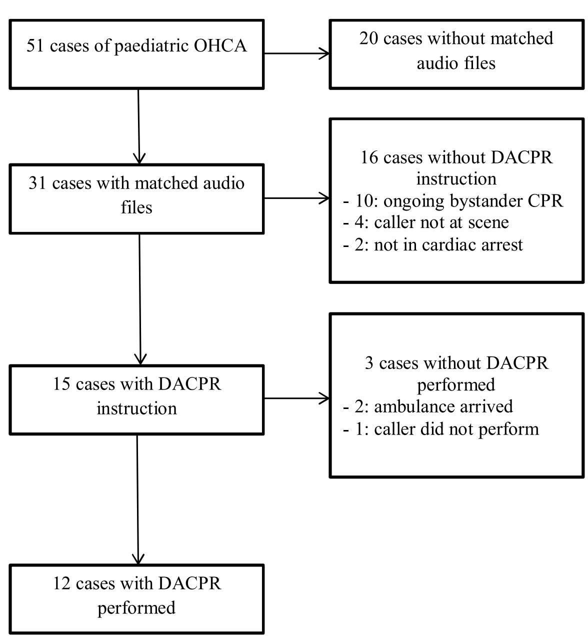

Fig. 3 – Study population.

Communication issues

In total, 60 communication issues were identified across the 31 cases, averaging 1.9 SACCIA incidents per call. Majority of the issues were related to sufficiency (n = 21, 35%) and accuracy (n = 21, 35%) of information. Thirteen percent (n = 8) was related to contextualisation, 10% (n = 6) to clarity and the remaining 7% (n = 4) to interpersonal adaptation. Encoding of messages by dispatchers was commonly compromised by insufficient informational content (n = 14, 23%). Transactional communication between dispatchers and callers lacked accuracy (n = 11, 18%). Decoding of messages was also inaccurate (n = 4, 7%). See Table 2 for examples.

SACCIA principles

The above issues in DACPR were further classified into the seven SACCIA root cause principles of human communication,[17] ordered by their frequency of occurrence in our dataset:

Principle 1: redundancy in content and directness in channel enhance accuracy

This principle postulates that the likelihood of attaining shared understanding increases when the dispatcher and caller repeat message content appropriately (i.e. when it aids transmission of information but not unnecessarily often) through direct rather than indirect means. Although continuous counting of chest compressions together by the caller and dispatcher was specified in the protocol, callers were not counting out loud nor were they instructed to do so in most of the cases (94%). One dispatcher gave instructions to perform compressions, but did not indicate to "pump hard and fast" nor did mention the depth of compression or instruct this using different verbatim. This resulted in the rescuer having to ask for further instructions. Repeated requests or reminders to co-count could contribute to guideline adherence. In other cases, however, there seemed to be an over-use of redundancy. For example, in one case a dispatcher said: "Hello. Hello. You understand, you understand?" Words and sentences were repeated unnecessarily. Thus, redundancy is an essential accuracy-promoting interpersonal validation process, but it must be used appropriately.

Principle 2: communication is functional

Some communication issues in this study were related to the function of the DACPR protocol. Compression-only CPR was instructed in 80% of the cases, although the protocol stated conventional CPR with chest compression and ventilation for paediatric cases. We had observed instances when instructions for conventional CPR were given, the ratio of chest compression to ventilation differed from protocol. The rate of compression was inadequate in 73% of the cases, all falling below 100 compressions per minute. In one

Table 2 – SACCIA® categorization of DACPR communication issues with examples.

Category	N (%)	Type (%)	Exemplary issues found	Recommended areas for improvement
Sufficiency	21 (35%)	Encoding (23%)	The dispatcher does not elaborate whether someone else at the scene could be contacted for performing DACPR. The dispatcher refers to the use of the middle and ring fingers, but does not indicate the intensity of compressions.	To convey encompassing information.
		Transactional (10%)	The instructor asks the caller to co-count, but no co-counting is audible. The instructor repeats his request once more and continues to count himself. Upon start of the call, CPR is already ongoing on a student who drowned at a swimming pool. There is no check on the quality of the ongoing CPR, and no dispatcher guidance or assistance.	To increase informational follow-up and assistance for the caller.
		Decoding (2%)	The dispatcher does not ask for the age of the patient but simply applies an adult algorithm.	To extract enough patient information.
Accuracy	21 (35%)	Encoding (10%)	To identify the geographical location, the block number is asked instead of the postal code (which is indicated in the template). The dispatcher indicates that CPR could be slowed down a bit, while the rate was actually going ok. CPR is performed with 15 compressions and 2 breaths, while the protocol states 30 compression and 2 breaths.	To provide information in alignment with the protocol or guidelines.
		Transactional (18%)	The caller indicates that the baby is vomiting out milk. The dispatcher assumes that this must block potential airflow and instructs to put the baby facing downwards and tap at the back 5 times. The Indian language /dialect used by the caller causes a misunderstanding by the dispatcher.	To engage interpersonal communication as a mechanism to validate the accuracy of treatments and processes.
		Decoding (7%)	The caller says to the dispatcher "He is gone." She refers to the person who was previously in the room. The dispatcher however thinks that it refers to the patient and tries to motivate her to continue CPR ("Don't give up").	To draw correct conclusions and to be careful about accurate message interpretations.
Clarity	6 (10%)	Encoding (7%)	The reported road is Cending Road, but the dispatcher is not able to locate it. A long discussion on Cending ('cashew') or Pending ('potato') starts. Finally, the dispatcher confirms that it must be Pending Road, close to the Bukit Panjang Ring Road. The first caller is not at the scene and cannot give details ('Don't know lah'), while the dispatcher assumes that he is at the scene.	To use clear language and provide clear instructions.
		Transactional (2%)	The dispatcher asks whether CPR is being performed, but initially there is no answer. The bystander did not understand what the dispatcher asked.	To engage interpersonal communication as a mechanism for reducing uncertainty and clarifying message content
		Decoding (2%)	The dispatcher indicates "I need you to do 100 beats per minute" instead of "*at least* 100 per minute", and is unclear for the caller what this rate entails.	
Contextualisation	8 (13%)	Encoding (6%)	The agent asks what happened first, before asking for the address of the scene.	To use communication for contextualizing the remote setting and patient situation.
		Transactional (7%)	The caller says to the dispatcher "He is gone." She refers to the person who was previously in the room. The dispatcher however thinks that is refers to the patient and tries to motivate her to continue CPR ('Don't give up'). The person says 'I am very tired' after a couple of minutes of performing CPR. The dispatcher does not ask whether a second person is available to take over the CPR	To engage communication for context-based coordination.
Interpersonal adaptation	4 (7%)	Encoding (3%)	The dispatcher says: "Hello. Hello. You understand, you understand?" Words and sentences are repeated and the tone is confrontational.	To pay attention to relationship-building communication, particularly to nonverbal "vocalics" (e.g. tone and inflection of voice, speaking rate), because they convey as much information as *what* is said.
		Transactional (2%)	While co-counting happens, during the course of CPR no encouragements or confirmation of quality of the CPR is given.	To provide interpersonally adaptive (i.e. needs-based) encouragements during CPR.
		Decoding (2%)	The caller complains multiple times that it takes such a long time for the ambulance to arrive. Only after a while, the dispatcher indicates that the ambulance comes from Tampines.	To recognize and respond to the caller's expressed needs and expectations during the CPR

encounter, the dispatcher asked to slow down the chest compression rate when it was within the recommended 100–120 compressions per minute. Different counting methods were observed, from "1, 2, 3, 4, 5, . . . , 10; 2, 2, 3, 4, 5 . . . , 10, . . . " to "1, 2, 3, 4, 5, . . . , 30" in 10 cases and "1 and 2 and 3 and 4 and 5, 1 and 2 and 3 and 4 and 10, . . . and 30" in 1 case, and it was unclear whether the dispatchers were still able to achieve the intended rates. Communication pursues various functions but the main function of DACPR must pursue the function of protocol adherence to maximize safety and outcomes.

Principle 3: preconceptions and perceptions vary among communicators

This principle of human communication states that dispatcher and caller enter their call with different preconceptions and will perceive each other's communication differently. This also applies to written communication, where such preconceptions manifest themselves in written scripts. Twelve percent of the issues we found evidenced a "common ground fallacy": both the dispatcher and the caller generally assumed that they will understand what they tell one another.[15] For example, a dispatcher did not give instructions for the positioning of the fingers. The caller needed to ask "I wonder where I do press?" resulting in time loss. Recognition of this safety-compromising fallacy is critical. Transactional communication that pursues a shared understanding is the pathway to preventing such misunderstandings.

Principle 4: communication is contextual

While the setting of DACPR is to some extent straightforward as there are only two persons involved in the communication process, the meaning of a message is always influenced by the context in which the interaction takes place. In one case, the caller said, "I am very tired" after a couple of minutes of performing CPR. The dispatcher might have recorded the actual fact but did not contextualize it to the situation in which the caller was positioned, and did not follow-up with safety-enhancing actions (e.g. ask whether a second person was available to take over the CPR).

Principle 5: communication varies between thought, symbol, and referent

Humans "make meaning" through the creation and use of symbols (e.g., words, gestures, sounds, images, artefacts). This process is construed through triangular associations: a referent (e.g., "the patient") is connected to a thought (i.e., a cognitive association with the word "the patient"), which again is represented by a chosen vocabulary (e.g., "the baby" or "Paul"). During one call, the dispatcher heard the sound of a crying baby in the background and asked, "Is the baby crying?" The father answered, "No, that's my other daughter." In another case, the caller said, "He is gone", with 'he' referring to a third party present at the scene (i.e. the intended thought was "he has left"), but the dispatcher thought "he" referenced the victim (i.e. the misunderstood thought was "he has died") and thus continued to encourage the caller by saying, "don't give up" which caused confusion during the DACPR process. In a phone-only way of DACPR communication, this kind of misinterpretation of a single word or phrase constitutes a common threat to successful DACPR.

Principle 6: communication is more than words

In face-to-face communication, verbal messages are always accompanied by nonverbal behaviours such as visible and vocal cues, gestures and tone of voice. In the context of DACPR, decoding of such nonverbal communication is limited. In one case, the dispatcher needed to repeat questions multiple times ("how old, how old, girl, how old"). In addition to the words the dispatcher was saying, the tone, tempo, and volume constituted non-verbal messages that were being communicated and perceived as confrontational. This created an interpersonal barrier between the caller and the dispatcher and discouraged the caller from cooperating with further questions. In the dispatcher centre, only audio communications are available, and there is no visual feedback to the dispatcher. However, such vocalics constitute a main information carrier: significantly more meaning is attributed to nonverbal (rather than verbal) communication. Therefore, the importance of vocalics (i.e. the use of the voice such as tone, volume, speed etc.) for safe DACPR is critical to recognize, because it constitutes an essential resource for preventing misunderstandings.

Principle 7: communication entails factual and relation information

This final principle postulates that communication always conveys both factual and relational information. In the example referred to earlier where a dispatcher said "Hello. Hello. You understand, you understand?", a perceived sense of doubt about the caller's competence may be accidentally conveyed nonverbally along with factual CPR instructions. Non-verbal communication can be decoded in multiple ways, even if the words contain only factual information. Communication entails verbal and nonverbal information that carry both informational and relational meaning.

Discussion

Our study showed that DACPR increased the provision of bystander CPR as the callers would not have started if not instructed by the dispatcher. Based on our findings, communication safety during the call could be improved with additional training addressing the quality of the (technical) instructions, handling overly distraught callers and language issues.

As with previous reports,[4,5,8–10] DACPR is an effective strategy to increase the performance of bystander CPR in both adult and paediatric OHCA. We found that dispatcher' technical instructions on giving ventilations for paediatric patients (as opposed to compression-only CPR) could be improved, taking reference from local paediatric resuscitation guidelines.[18] Nonetheless, compression-only DACPR is still effective when good quality chest compressions are performed[19,20] and this is especially relevant when bystanders are reluctant to perform rescue breaths

Paediatric OHCA is a rare event. We postulate that due to the low incidence of paediatric cardiac arrests (compared to adult arrests), dispatchers may tend to instruct bystanders to do compression-only because of their natural familiarity with the adult DACPR protocol. Another possible reason for dispatchers not instructing ventilation may be the difficulty in providing technically detailed instructions for ventilation, causing them to deviate from protocol and abandon ventilations to ensure that chest compressions are uninterrupted.

In line with the previous study on barriers to DACPR in multilingual Singapore,[14] we did observe some language barriers, albeit minimal. This could be due to the fact that the majority of the callers, parents or caregivers of the paediatric cardiac arrest victims, tended to be younger and were thus more likely able to be fluent in English then the older general population.

Consistent with previous SACCIA studies, issues related to sufficiency in communication were most common, but the amount of issues related to clarity was higher in our study.[21–24] This implies the need to focus on these two aspects of DACPR communication. There is an existing line-by-line dispatching script in English. In multilingual Singapore, however, the dispatchers will occasionally need to translate this script to the other local languages (Mandarin, Tamil, Malay) and even into dialects (e.g., Hokkien, Teochew). The script has to balance simplification and specification as it has been shown that simplified DACPR instruction can improve CPR quality.[25–30] Validation studies are needed to examine, for instance, whether the use of 'push as hard as you can' can achieve greater depth and rate of compression than 'push approximately 4cm'. Clear and simple technical instructions are necessary as the bystander will be under emotional distress during paediatric OHCA, which can compromise DACPR performance.[31–33]

Nonverbal communication cannot be disregarded in the context of DACPR where callers are often overly distraught. Ninety-three percent of the understanding of a message is derived from nonverbal communication such as kinesics (55%) and vocalic cues (38%), with the spoken words constituting only 7% of the meaning.[20] Even though kinesics are unavailable in phone communications, vocalic cues such as inflection of the voice, rate of talking, loudness, and expressivity contribute towards a shared understanding in DACPR.

We recommend that DACPR training for dispatchers should focus on appropriate repetition (e.g., engaging callers to actively count their compressions out loud). The training could also focus on the directness of the channel (using multiple functions of the smart phone to facilitate DACPR communication, e.g., video call,[34] GPS location, or specific app's[35,36]) and situation-specific script adherence (e.g., using computer prompts to emphasize important language specific details of the script). Other recommendations include the use of simulation to validate the translation of the DACPR script into different languages, and the use of a metronome to guide the dispatcher on correct compression rates. Furthermore, dissemination of information and public education on the DACPR guideline in OHCA may be useful to increase the population's awareness of the guideline content and readiness to perform DACPR when the need arises.

Limitations

Given the low incidence of paediatric cardiac arrest, we carried out a retrospective study. The most significant limitation was the inability to involve both dispatcher and caller for every case in order to understand their perspectives about instruction and communication issues during DACPR. Our observations were from a third-person perspective, based on the available audio, which may not have truly reflected the issues or the concerns of the dispatcher and caller. This might have impacted the categorization of the SACCIA® issues as communication issues are not always easy to distinguish and may fall under more than one category. Furthermore, the exact reasons behind non-compliance to current DACPR guidelines could not be ascertained as there was no documentation available and interviewing the dispatcher involved after the event would have introduced recall bias.

Conclusion

A structured evaluation of communication issues using the SACCIA® typology in paediatric DACPR for OHCA allowed identification of specific communication issues. We found an average of 1.9 communication issues per call. Majority of the issues were related to sufficiency and accuracy of communication. Our training recommendations focus on simulated situation and language-specific guideline application and moving beyond verbal communication by utilizing more functions of the smart phone. Prospective efforts are necessary to evaluate whether this translates into improved provision of paediatric DACPR.

Acknowledgements

The authors thank the SCDF Control Room Staff for their participation in this study.

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