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Review

A scoping review to determine the barriers and facilitators to initiation and performance of bystander cardiopulmonary resuscitation during emergency calls

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Abstract

Background: To maximise out-of-hospital cardiac arrest (OHCA) patients' survival, bystanders should perform continuous, good quality cardiopulmonary resuscitation (CPR) until ambulance arrival.

Objectives: To identify published literature describing barriers and facilitators between callers and call-takers, which affect initiation and performance (continuation and quality) of bystander CPR (B-CPR) throughout the OHCA emergency call.

Eligibility criteria: Studies were included if they reported on the population (emergency callers and call-takers), concept (psychological, physical and communication barriers and facilitators impacting the initiation and performance of B-CPR) and context (studies that analysed OHCA emergency calls).

Sources of evidence: Medline, CINAHL, Cochrane CENTRAL, Embase, Scopus and ProQuest were searched from inception to 9 March 2022.

Charting methods: Study characteristics were extracted and presented in a narrative format accompanied by summary tables.

Results: Thirty studies identified factors that impacted B-CPR initiation or performance during the emergency call. Twenty-eight studies described barriers to the provision of CPR instructions and CPR initiation, with prominent themes being caller reluctance (psychological), physical ability (physical), and callers hanging up the phone prior to CPR instructions (communication). There was little evidence examining barriers and facilitators to ongoing CPR performance (2 studies) or CPR quality (2 studies).

Conclusions: This scoping review using emergency calls as the source, described barriers to the provision of B-CPR instructions and B-CPR initiation. Further research is needed to explore facilitators and barriers to B-CPR continuation and quality throughout the emergency call, and to examine the effectiveness of call-taker strategies to motivate callers to perform B-CPR.

Keywords: Out-of-hospital cardiac arrest, Bystander cardiopulmonary resuscitation, Emergency medical dispatch, Barriers, Facilitators, Initiation, Continuation, Quality

Introduction

Out-of-hospital cardiac arrest (OHCA) is a time-critical emergency where patients require immediate life-saving actions.[1] The Chain of Survival describes a sequence of interventions to optimise an OHCA patient's chance of survival: early recognition of cardiac arrest, early bystander cardiopulmonary resuscitation (B-CPR), early defibrillation, advanced life support and evidence-based post resuscitation care.[2–3] Every minute delay to cardiopulmonary resuscitation (CPR) or defibrillation initiation is associated with a decreased likelihood of patient survival.[4] Lay bystanders are usually first on the scene and can provide basic life support measures until Emergency Medical Services (EMS) arrive.

The incorporation of dispatcher-assisted CPR (DA-CPR) instructions into the emergency call was an initiative designed to increase B-CPR rates.[5] DA-CPR, also referred to as telephone-CPR or telecommunicator CPR, is where the call-taker (dispatcher) instructs

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the bystander on how to perform CPR.[6–7] DA-CPR has been associated with increased rates of B-CPR, shortened time to defibrillation and favourable OHCA survival outcomes.[8–11] However, even with these instructions, B-CPR rates still remain low, with current global rates reported as low as 19%.[12]

Previous research has shown that there are barriers to each of the early links in the Chain of Survival. Recognition of cardiac arrest can be delayed by the non-detection of agonal breathing, a symptom that occurs in 40–60% of cardiac arrest cases.[13] During the emergency call, once the patient's condition has been identified as cardiac arrest, the role of the call-taker is to encourage the caller to commence B-CPR. Significant work to date has been undertaken to identify and address the barriers to the recognition of cardiac arrest and initiation of B-CPR.[14–17] However, patient survival is also dependent on good quality CPR being performed continuously from the point of recognition of cardiac arrest through to EMS arrival.[1] Previous work addressing CPR continuation and quality has commonly utilised simulation methodology to ascertain CPR metrics.[18–19] To our knowledge, there are no reviews that have examined barriers and facilitators, as identified through the emergency call, to B-CPR initiation and performance. Thus, we performed a scoping review to identify and summarise the published studies that utilised emergency call data (audio or transcripts) to identify the barriers and facilitators to the initiation, continuation, and quality of B-CPR. We chose scoping review methodology as it allows for a systematic mapping of the literature without being bound by a narrow research question.

Methods

This scoping review follows Arksey and O'Malleys[20] methodological framework and adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR).[21] Our findings are presented in a narrative format accompanied by summary tables. The search strategy followed a predefined protocol, published on Open Science Framework.[22]

Eligibility criteria

Articles were required to describe the following criteria: *population* (bystanders/callers who are directly involved in the ambulance emergency call and the call-takers who respond to these calls); *concept* (the psychological, physical and communication factors (barriers and facilitators) that impact on the performance (initiation, continuation and quality) of B-CPR); and *context* (ambulance emergency OHCA calls where the arrest was not witnessed by EMS and the patient could have received bystander CPR before EMS arrival). Studies had to use the emergency OHCA call audio (or transcripts of the audio) as the primary data source. Studies that focussed on OHCA recognition were not included in this review. However, if included studies also examined OHCA recognition, then only the data pertaining to CPR initiation, continuation and quality were extracted. The search was limited to articles with an English language abstract. Grey literature and conference abstracts were excluded from the review.

Search strategy and information sources

A three-step strategy (1. database search for relevant terms through text analysis, 2. keyword search across all chosen databases, 3. screening reference lists of included articles) was followed, as per the Joanna Briggs Institute[23] methodological framework for scoping reviews, searching six databases (Medline, Scopus, CINAHL, Cochrane, EMBASE and ProQuest) for eligible articles. Reference lists of articles that met the inclusion criteria were screened to identify additional articles. Our search strategy was developed in conjunction with an information specialist at Curtin University Library and adapted for each database. The search was run on 9 March 2022. No limit was placed on publication year, with each database searched from its inception. The search strategy for each database is shown in Appendix 1.

Study selection

Results from the searches were imported into Rayyan[24] for the removal of duplicates and screening. Authors EA and NP independently screened titles, abstracts and full-text articles against the selection criteria, with disagreements being resolved by discussion and consensus of both authors or referral to a third author (JF).

Data extraction and charting

Due to the large number of studies, we deviated from our registered protocol, with only a single author (EA) extracting the data, and another author (NP) verifying the data extraction. Characteristics of each study were extracted and entered into a Microsoft Excel spreadsheet [Microsoft, Redmond, NY, USA], including: authors, year of publication, country, study design, population, setting, sample size, barriers identified, facilitators identified, and strategies implemented. No risk of bias was conducted as per usual practice for scoping reviews.[23]

Synthesis of results

We grouped our findings into four predefined categories: psychological, physical, communication, and other barriers and facilitators to CPR performance, as per our protocol. We developed these categories after an initial search of the literature, using the following definitions to classify each factor: psychological factors were defined as any factors that affect or arise in the mind, or are related to the mental and emotional state of the bystander or call-taker; physical factors related to any patient or bystander physical characteristics or the environment in which the OHCA took place; and communication factors were defined as anything relating to what was spoken and how it was interpreted and responded to throughout the emergency call. Each factor was discussed and placed in its respective category after reaching consensus. Overlapping or ambiguous factors were placed in the most relevant category, after arbitration, to ensure factors were counted only once. Factors that did not fit into these categories were considered other factors. Each barrier or facilitator identified was categorised into one of these four categories (psychological, physical, communication, other) and described narratively.

To describe which aspects of B-CPR were affected by the various barriers and facilitators, we utilised the following definitions to standardise data extraction and synthesis: initiation of CPR was defined as the provision of DA-CPR instructions and the subsequent first compression as recorded by the call-taker; CPR continuation was the ongoing performance of chest compressions with or without rescue breaths; and CPR quality was any reference to the bystander's compression rate, depth, recoil or breaks between compressions. The findings were then grouped by factor category (psychological, physical, communication, other) and synthesised into subgroups based on which aspect they affected (initiation, continuity, quality).

Results

The search process retrieved 15,776 articles from the six databases (Fig. 1). After applying the inclusion and exclusion criteria to screen titles and abstracts, 165 publications/articles underwent full-text screening. Of these, 134 did not meet inclusion criteria and were excluded from the review, and 31[25–55] articles met the inclusion criteria and underwent data extraction and summary. Twenty-nine of the included articles related to individual studies,[25–52,55] and two articles were from the same study.[53–54] Thus, the review included a total of 30 studies.

Study characteristics

The characteristics of each study are summarised in Table 1. The studies included were conducted across 12 different countries, with the most being from the United States of America. Study sizes ranged from 21 participants[35] to 3000 participants.[43] Four[26,36,53,55] of the included studies reported the introduction of and/or the impact of DA-CPR per se, with the other 27 studies describing the impact of various factors on B-CPR initiation and performance.[25,27–35,37–53] All studies were performed within systems that utilised a standardised DA-CPR script for OHCA calls. Fifteen studies included cases where OHCA was suspected by the call-taker at the time of the emergency call[26–27,29,33–36,40–41,43–44,49–51,55] and 14 studies solely included cases with EMS confirmed/treated OHCA.[25,28,30–32,38–39,42,45–48,53–54] In two studies it was unclear if the cases were EMS-confirmed OHCA (after arrival on scene) or only suspected by call-taker to be OHCA.[37,52] Two studies limited their included cases to those where CPR was not initiated,[25,32] 12 studies utilised cases where only DA-CPR was implemented,[29,34,36–38,45,47–51,55] 15 studies included OHCA cases with or without CPR performed,[26–28,30–31,33,35,39–41,43–44,52–54] and two studies only included cases where either B-CPR or DA-CPR was performed.[42,46].

Twenty-eight studies examined the initiation of B-CPR.[25–41,43,45–49,51–55] Two studies described factors that impacted the ongoing performance of B-CPR.[36,55] Two studies examined the quality of B-CPR[42,50] and the factors that affect it (Table 2). All factors identified throughout the review are summarised in Tables 3 and 4.

Psychological factors

Psychological factors were common, reported by 24 studies (Table 2). We categorised these factors into four overarching themes: reluctance (or unwillingness), emotional distress, confidence and fear (or trepidation).[25–48] These themes contain 22 unique psychological barriers[25–48] and two psychological facilitators.[36,40] Psychological factors were reported to predominantly impact both the provision of CPR instructions and the initiation of CPR following instruction provision, with no barriers to CPR continuation and quality and two facilitators to the continuation of CPR described in the literature.[36]

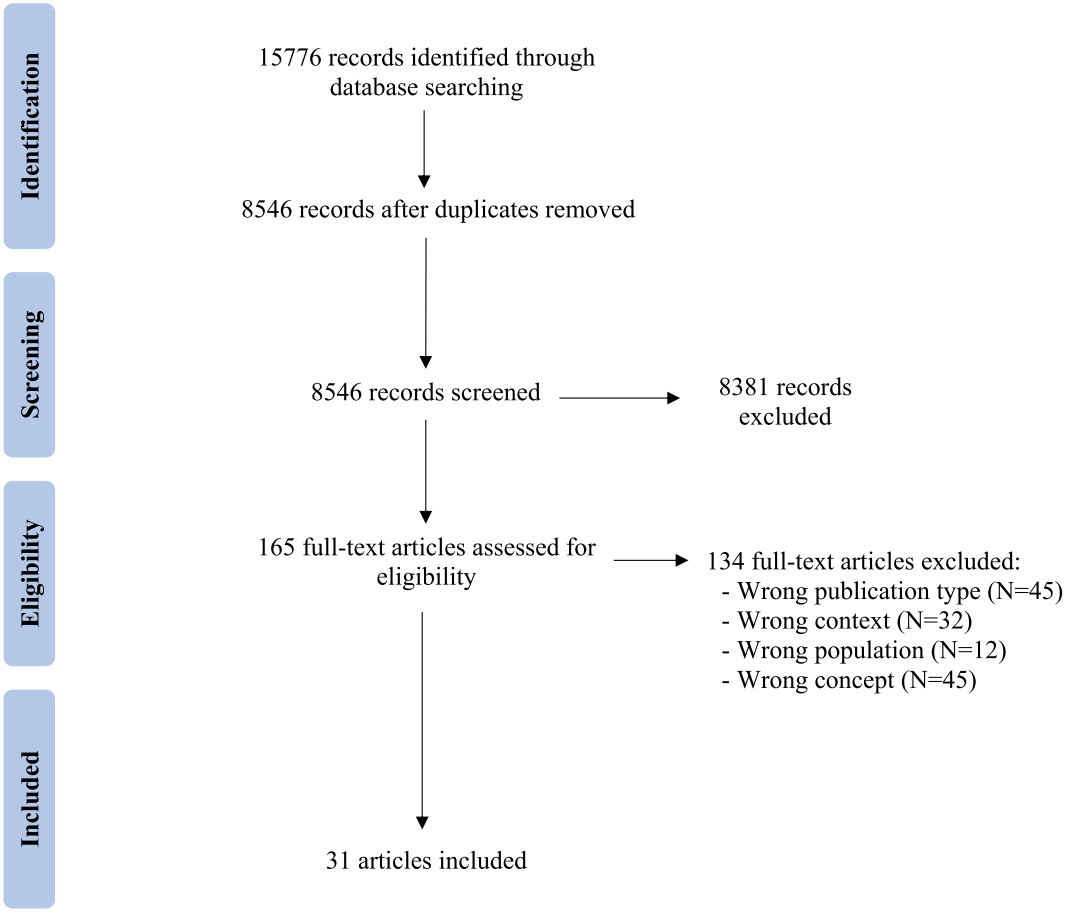

Fig. 1 – PRISMA flowchart.

Table 1 – Article characteristics.

First author, year	N	Country	Study design	Data source	Study population	
Bang, 2000[41]	99	Sweden	Cohort study	EMS calls	Suspected OHCA	Calls with/without CPR performed
Case, 2018[25]	139	Australia	Qualitative review	EMS calls	EMS confirmed OHCA	CPR not initiated
Cheng Yu, 2019[40]	367	Taiwan	Cross sectional study	EMS calls	Suspected OHCA	Calls with/without CPR performed
Chocron, 2021[42]	428	USA	Cohort study	EMS calls, EMS and hospital records	EMS treated OHCA	B-CPR & DA-CPR
Clegg, 2014[43]	50	UK	Cohort study	EMS calls	Suspected OHCA	Calls with/without CPR performed
Culley, 1991[26]	267	USA	Cohort study	EMS calls	Suspected OHCA	Calls with/without CPR performed
Dami, 2015[29]	1254	Switzerland	Cohort study	EMS calls, dispatcher form	Suspected OHCA	DA-CPR
Deakin, 2010[27]	42	UK	Cohort study	EMS calls, patient record form	Suspected OHCA	Calls with/without CPR performed
Fukushima, 2016[28]	1850	USA	Cohort study	EMS calls	EMS confirmed OHCA	Calls with/without CPR performed
Hardeland, 2021[44]	716	Denmark, Norway, Sweden	Cohort study	EMS calls, OHCA database, national CA registry	Suspected OHCA	Calls with/without CPR performed
Hauff, 2003[30]	404	USA	Cohort study	EMS calls	EMS treated OHCA	Calls with/without CPR performed
Heward, 2004[31]	100	UK	Cohort study	EMS calls	EMS confirmed OHCA	Calls with/without CPR performed
Ho, 2016[32]	1157	Singapore	Cohort study	EMS calls	EMS confirmed OHCA	CPR not initiated
Huang, 2020[55]	2404	Taiwan	Cohort study	EMS calls, OHCA database	Suspected OHCA	DA-CPR
Langlais, 2017[45]	802	USA	Cohort study	EMS calls, first care and hospital records	EMS treated OHCA	DA-CPR
Leong, 2021[49]	506	Singapore	Cohort study	EMS calls	Suspected OHCA	DA-CPR
Lerner, 2008[33]	343	USA	Case series	EMS calls	Suspected OHCA	Calls with/without CPR performed
Lewis, 2013[34]	476	USA	Cohort study	EMS calls	Suspected OHCA	DA-CPR
Linderoth, 2021[50]	52	Denmark	Cohort study	Video calls	Suspected OHCA	DA-CPR
Linderoth, 2015[35]	21	Denmark	Cohort study	EMS calls, CCTV	Suspected OHCA	Calls with/without CPR performed
Martinage, 2013[36]	38	France	Cohort study	EMS calls	Suspected OHCA	DA-CPR
Michiels, 2020[37]	123	Belgium	Cohort study	EMS calls	Unclear	DA-CPR
Nuno, 2017[51]	39	USA	Cohort study	EMS calls, CAD records	Suspected OHCA	DA-CPR
O'Neil, 2007[46]	145	UK	Cohort study	EMS calls, ambulance records	EMS confirmed OHCA	B-CPR & DA-CPR
Pek, 2019[52]	31	Singapore	Cohort study	EMS calls, ambulance records	Unclear	Calls with/without CPR performed
Riou, 2021[47]	422	Australia	Cohort study	EMS calls	EMS confirmed OHCA	DA-CPR
Riou, 2020[48]	65	Australia	Cohort study	EMS calls	EMS confirmed OHCA	DA-CPR
Riou, 2018[38]	424	Australia	Cohort study	EMS calls	EMS confirmed OHCA	DA-CPR
Sanko, 2020[54]	597	USA	Cohort study	EMS calls	EMS confirmed OHCA	Calls with/without CPR performed
Sanko, 2021[53]	61	USA	Cohort study	EMS calls	EMS confirmed OHCA	Calls with/without CPR performed
Siman-Tov, 2021[39]	2310	Israel	Cohort study	EMS calls	EMS confirmed OHCA	Calls with/without CPR performed

Table 2 – Topics examined by each study.

First author, year	Providing instructions	Initiating CPR	Continuing CPR	Maintaining CPR quality	Psychological factors	Physical factors	Communication factors
Bang, 2000[41]		●			●	●	
Case, 2018[25]	●	●			●	●	●
Cheng Yu, 2019[40]	●	●			●	●	●
Chocron, 2021[42]				●	●	●	
Clegg, 2014[43]		●			●	●	
Culley, 1991[26]		●			●	●	●
Dami, 2015[29]	●	●			●	●	●
Deakin, 2010[27]		●			●	●	●
Fukushima, 2016[28]	●	●			●	●	●
Hardeland, 2021[44]	●	●			●	●	
Hauff, 2003[30]	●	●			●	●	●
Heward, 2004[31]	●	●			●	●	●
Ho, 2016[32]	●	●			●	●	●
Huang, 2020[55]	●	●	●			●	
Langlais, 2017[45]		●			●	●	
Leong, 2021[49]	●	●					●
Lerner, 2008[33]	●	●			●	●	●
Lewis, 2013[34]	●	●			●	●	●
Linderoth, 2021[50]				●	●	●	●
Linderoth, 2015[35]		●					●
Martinage, 2013[36]		●	●		●	●	●
Michiels, 2020[37]		●			●	●	●
Nuno, 2017[51]	●	●					●
O'Neil, 2007[46]		●			●	●	
Pek, 2019[52]	●	●					●
Riou, 2021[47]		●			●	●	●
Riou, 2020[48]		●			●		
Riou, 2018[38]		●			●		
Sanko, 2020 2021[53–54]		●					●
Siman-Tov, 2021[39]		●			●	●	●

Psychological factors: Providing instructions and initiating CPR

Bystander reluctance to intervene was a significant barrier to the provision of instructions and initiation of CPR. In fact, of the four psychological themes reluctance was the most commonly described. Bystanders' reluctance to initiate CPR was often in response to patient characteristics, with patients who were perceived dead by the caller or had a known terminal illness less likely to be provided with instructions or have CPR initiated.[29,35,47] However, reluctance was also seen when the bystander believed the patient was alive.[29] Riou et al.[48] found that bystanders who initially resisted performing CPR, based on their perceptions of the patient's status, are less likely to be persuaded than those who initially resisted performing CPR based on their perceived ability to perform CPR. Disagreeable patient characteristics,[30,33] caller repulsion of patient,[36] patient's age[47], and sex (male)[42] were identified to inhibit or delay B-CPR initiation, as were DA-CPR protocols that asked bystanders to perform mouth-to-mouth resuscitation, as opposed to compressions only CPR.[46] One study found that bystanders calling EMS for unwitnessed arrests were less likely to receive DA-CPR instructions, with 13% of unwitnessed arrests being provided with CPR instructions compared with 26% of witnessed arrests.[25] One study found that if the patient was unknown to the bystander, the bystander was less likely to perform CPR.[33] Bystander reluctance also took the form of bystander questioning the perceived patient benefits of CPR, or whether CPR was the correct action to take, thus delaying CPR initiation.[25,34–35,38,43] Michiels et al.[37] found that bystander lack of motivation was a common barrier to B-CPR, occurring in 44% of calls, even with call-taker encouragement.

In some cases, the callers' emotional distress, in the form of hysteria and panic, prevented or delayed the provision of DA-CPR instructions.[34,40] For one study this was particularly evident in cardiac arrests that were witnessed.[25] The caller's emotional state was also a commonly identified barrier to the initiation of CPR.[25–30,32–34,37,40–41] Case et al.[25] noted that caller panic was more likely to be present when the caller was an unassisted female who did not believe that she could move the patient, or when the arrest occurred in public with multiple bystanders on the scene.[25]

Bystanders' confidence in their skills and ability to perform CPR, and previous exposure to OHCA or CPR, influenced their reactions to being asked to perform CPR.[25,35–36,38] If bystanders felt that they were unable to perform CPR, either through a skill deficit[25,38] or perceived inability,[36] they were less likely to initiate B-CPR, despite DA-CPR protocols. Bystanders' lack of CPR skills and knowledge was identified as a significant deterrent to CPR initiation and performance.[26,29–30,33,36].

Bystanders' fears prevented them from initiating CPR. Fears of hurting the patient,[38] communicable diseases[37] and medicolegal issues[30,33] arising from performing CPR were also documented as reasons given for delaying or preventing CPR initiation. Martinage

Table 3 – Barriers identified, main themes are in bold.

	Psychological barriers	Physical barriers	Communication barriers
Providing instructions and initiating CPR	**Reluctance**[25,29-31,33-38,43,46,47]	**Bystanders' physical limitations**[25,28-31,33,34,36-40,43-46]	**Caller hung up**[32–34,36,38–40]
	Caller repulsed		**Caller refused**[28,32–34,37,39]
	Patient has terminal illness	Physically unable to perform CPR	**Deviations from protocol**[26,27,32,33,35,37,52]
	Perception of patient wishes	Unable to move patient	Poor/inadequate instructions
	Perceived appropriateness	**Patient difficult to access**[25,27,28,32,36,41,55]	Instructions not offered
	Perceived benefit		**Wording**[38,49,53,54]
	Performing ventilations	**Caller not present on scene**[26,28-32,35,36,39,41,44]	Technical language
	Perceived alive		How directions are worded
	Perceived death	**Bystander calling from landline**[55]	**Communication failure**[37,52]
	Patient age		Lack of understanding
	Patient sex (male)		Language barrier
	Obvious death		**Caller providing inadequate information**[35]
	Unwitnessed OHCA		
	Relationship to patient		**Caller relaying instructions to other bystanders**[27,35]
	Emotional distress[25–30,32–37,40,41]		
	Hysteria		**Caller asked to perform another task**[35]
	Panic		**Caller required persuasion**[27]
	Caller confidence[25,35,36,38,48]		**Establishing location**[27]
	Lack of skills		**Late identification**[25]
	Perceived ability		**Telecommunication issues**[25,32,33,36]
	Fear[25,29,33,36,38]		**Dispatcher hung up**[35]
	Fear of contact		**Call-taker lack of responsibility over resuscitation**[35]
	Fear of dead patient		
	Fear of hurting patient		
	Medicolegal concerns		
	Apprehension		
Continuing CPR	-	-	-
CPR quality	-	**Single bystander**[42]	-
		Phone call (audio)[50]	

Table 4 – Facilitators identified, main themes are in bold.

	Psychological facilitators	Physical facilitators	Communication facilitators
Providing instructions and initiating CPR	–	**Callers using a mobile phone**[55]	**DA-CPR**[26,36,39,53,55]
		Calls transferred from a landline to mobile phone	**Simple language**[49]
		Bystander characteristics[30]	
		Younger bystanders	
		Son or daughter versus spouse	
		Witnessed arrest	
		Multiple bystanders present	
		Public OHCA[28]	
Continuing CPR	**If bystanders have had CPR training**[36]	**Callers using a mobile phone**[55]	-
	Patient unrelated to bystander[36]	**Bystander adheres to DA-CPR protocol**[36]	
CPR quality	-	**Multiple bystanders**[42]	-
		Video emergency call[50]	

et al.[36] found that bystanders who were apprehensive about performing CPR were less likely to actually perform it.

Psychological factors: Continuation of CPR

Of the two studies[36,55] that examined ongoing CPR performance, neither identified psychological barriers, however one found that if bystanders had CPR training they were more likely to continue performing CPR till EMS arrived.[36] One of these studies also found that if the bystander was not related to the patient, CPR was more likely to continue till EMS arrived.[36]

Physical factors

Twenty-three studies identified physical factors that affected B-CPR initiation and performance, with 17 unique factors described across the literature.[25–46,55] Barriers to the provision of instructions and initiation of CPR were the most common, with four unique barriers described: physical limitations, patient difficult to access, caller not present on scene, bystander calling from a landline.[25–34,36,39–41,43–47,55] Two physical barriers to CPR quality were identified,[42,50] however no physical barriers to the continuation of CPR were identified in the included literature. Physical factors that facilitated CPR performance were also commonly described, with six facilitating factors for CPR initiation,[28,30,38,55] two for CPR continuation[36,55] and two for CPR quality.[42,50].

Physical factors: Providing instructions and initiating CPR

Physical barriers to B-CPR initiation and performance were commonly experienced by bystanders. The caller's proximity to the patient was a common barrier to both the provision of instructions and performing CPR, as the caller was often not with the patient[26,28,31–32,36,39,41,44] or the patient was difficult to access.[32,36,45] One study found that bystanders calling from a landline took longer to initiate CPR than if they were calling from a mobile phone, as they tended to be further away from the patient.[55] When the patient was close to the bystander, the caller's physical capacity often limited CPR initiation.[25,28–30,32–34,36–39,44–46] Bystanders inability to position the patient, due to the patient's weight or position (e.g. wedged between a wall and toilet) was common,[25,28–32,34,36–38,45–46] occurring in as many as 49%[45] of calls. Bystanders' physical inability to compress the patient's chest was identified as a significant barrier to CPR initiation.[25,28,30,33,36–37,39,44–45].

Physical factors that facilitated initiation of CPR were more commonly described than psychological or communication facilitators. One study found that calls to EMS from a mobile phone (as opposed to a landline/fixed line) were associated with a shorter time from call start to first compression, with higher rates of DA-CPR performance and shorter duration to CPR instruction.[55] Callers that were transferred from a landline to a mobile phone were associated with higher rates of DA-CPR, 73% vs 29% for non-transferred calls.[55] Four bystander characteristics were identified as facilitators: 1) younger bystanders,[30] 2) son or daughter instead of spouse,[30] 3) witnessed arrest,[30] and 4) having multiple bystanders present.[30] Another study found that if the OHCA occurred in a public location, the patient was more likely to receive CPR.[28]

Physical factors: Continuation of CPR

Of the two studies that examined ongoing CPR performance (continuation), neither commented on physical barriers to B-CPR continuation.[36,55] However, they identified two physical factors which facilitated the continuation of B-CPR: 1) if the call to EMS was made via a mobile phone,[55] and 2) if the bystanders immediately adhered to the DA-CPR protocol.[36]

Physical factors: CPR quality

Two studies reported on B-CPR quality.[42,50] Chocron et al.[42] assessed B-CPR compression rate and interval, by recording bystanders' counting of compressions during the emergency calls. One study found that the presence of only one bystander was an apparent barrier to the provision of good quality CPR, whereas B-CPR quality improved when two or more bystanders were present.[42] Linderoth et al.[50] used video emergency calls to assess B-CPR performance and provide real-time feedback to bystanders. Using video EMS calls was considered a facilitator of CPR quality as it improved the call-takers perceived B-CPR quality.[50]

Communication factors

Twenty-one studies reported 16 themes relating to 17 unique communication barriers[25–40,49–54] and two communication facilitators to

the initiation and performance of B-CPR.[39,49,53–54] Communication barriers were documented as disproportionately affecting the provision of CPR instructions and initiation of CPR, with 18 studies describing barriers to this phase of CPR performance.[25–27,29,32–34,36–38,40–42,49,51–52] One study identified a communication barrier to CPR quality.[35] Four studies described communication related facilitators to the initiation of CPR.[39,49,53–54] No communication barriers or facilitators to the continuation of CPR were examined in the literature.

Communication factors: Providing instructions and initiating CPR

Communication barriers to providing instructions and initiating CPR were commonly identified, with the primary barrier to the provision of CPR instructions and CPR initiation being telecommunication issues, where the caller disconnected prematurely[29,32–34,36,40] or there was a bad connection.[33,36] This was followed by deviations in protocols by the call-taker, leading to a breakdown in understanding or the caller/call-taker relationship.[26,31,33,35,37,41,46,52] Asking irrelevant or extra questions,[26,46] failing to ask key questions,[41] not offering DA-CPR instructions,[31,37] omitting words,[26] or offering instructions at inappropriate times[35] all impacted on bystanders' willingness to perform CPR. How call-takers pose prompts to the bystanders impacted bystander willingness to perform CPR, with Riou et al.[38] showing that bystanders were less likely to agree to do CPR when asked in terms of their willingness, than when told that CPR needed to happen or was going to happen. In addition, if call-takers gave poor or inadequate instructions,[27,32] used technical language such as "push 100 times a minute at a depth of five centimetres",[49] or callers were confused about the instructions given,[36] CPR initiation was delayed. The script used to provide bystanders with instructions can prolong the time to DA-CPR through bystander confusion and further clarification of instructions.[42] If the call-taker did not take responsibility for the resuscitation and leadership of the call, CPR was unlikely to occur.[35]

Breakdowns in communication between the caller and call-taker occurred when the caller was relaying questions and instructions to other bystanders,[35,46] delaying the initiation of CPR. One study found that information was not passed on to the bystanders performing CPR by the caller, leading to delays in CPR initiation.[35] Language barriers, defined as a lack of common language between the caller and call-taker, were common and delayed the delivery of instructions and initiation of CPR.[25–26,28,30–32,34,51,53] Nuno et al.[51] found calls with language barriers had significant delays to CPR initiation.

Studies reported DA-CPR to be positively associated with B-CPR initiation,[26,36,39,53,55] as was the use of simple language such as "push hard and fast" when explaining to bystanders how to perform CPR.[49] One study, published in two separate articles, found that a modified script (Los Angeles Tiered Dispatch System LA-TDS) increased B-CPR rates by 57% and significantly improved achievement of the first compression in less than two minutes when compared with the Medical Dispatch Priority System (MPDS).[54] The modified script, also improved B-CPR initiation rates for non-native English speakers.[53]

Communication factors: CPR quality

One study found that when call-takers provided instructions to bystanders, if they did not ask for feedback or check if the bystander understood the instructions, this resulted in perceived suboptimal chest compressions as assessed through CCTV footage.[35] When multiple bystanders were present, the call-taker did not always prompt to rotate CPR providers, when poor quality CPR was being performed, as assessed by the call-taker through the video call.[50]

Other factors

No other factors, barriers or facilitators, were identified to impact on B-CPR.

Discussion

This scoping review identified 30 studies that documented barriers and facilitators identified through the emergency call to impact B-CPR initiation and performance.[25–55] Barriers to the provision of DA-CPR instructions and CPR initiation were most commonly addressed in these studies, with prominent themes being bystander reluctance (psychological),[25,29–30,33–36,38,46,48] physical ability (physical),[25,28–30,32–34,36–40,44–46] and callers hanging up the phone prior to CPR instructions (communication).[26,28–30,32–34,36,38–40] Bystander reluctance was identified as the most common psychological barrier to the provision of DA-CPR instructions and CPR initiation. Facilitators were not commonly documented, but when they were identified they were predominantly physical factors (e.g. multiple bystanders on scene, younger bystanders, witnessed arrest, and using a mobile phone to call EMS). The process of initiating and performing B-CPR is dependent on OHCA recognition, thus delayed recognition has flow-on effects, pushing out time to instruction provision, however, B-CPR becomes redundant when EMS arrive and can take over. Similarly, if the patient achieves a return of spontaneous circulation (ROSC) prior to DA-CPR instructions being provided.

This review highlighted that little is known regarding bystanders continuing CPR or maintaining CPR quality till EMS arrive on the scene and the caller-coaching methods that call-takers may employ. No single study addressed factors that impact all three components of B-CPR performance (initiation, continuation, and quality), however, the psychological, physical and communication factors impacting initiation are well identified in the literature. The limited research to date on CPR continuation and quality highlights the importance of understanding these issues further. For example, CPR continuation to EMS arrival was found to be less likely if the bystander was not related to the patient or if they did not know first aid,[36] and real-time verbal feedback via live video streaming improved B-CPR quality.[50] While visual assessments of CPR are subjective and not necessarily accurate,[56] without formal measuring equipment available on the scene, video emergency calls may be the best method to ensure that optimal CPR is being performed. Using a video emergency call system also allows call-takers to provide advice and visual support that could motivate callers to continue performing B-CPR in circumstances where they might have given up.[50]

There are significant barriers experienced by bystanders and call-takers during the OHCA emergency call that impact CPR initiation and performance, some of which are modifiable and provide a potential opportunity for improving CPR rates. For example, Riou et al.[48] suggested that if callers demonstrate hesitancy, the call-takers could provide more context about OHCA and the reasons for performing CPR to help motivate callers. To minimise call-taker freestyling and deviating from the script, which can act as communication barrier,[26,31,33,35,37,41,46,52] call dispatch systems could have a repertoire of prompts that call-takers can draw from to provide context to callers

and encourage them to perform CPR. Other studies have found that training programs can improve recognition of OHCA and the need to start DA-CPR.[57–58] Ongoing training for call-takers on how to handle callers reluctant to perform CPR could also be useful, to minimise deviations from the script and increase B-CPR rates. Emergency calls for OHCA are an infrequent call for individual call-takers, therefore consistent training may help them to effectively support callers to perform B-CPR.

Education can similarly prepare the public to perform B-CPR, through improving willingness and confidence in CPR performance skills.[59–60] Public education programs, such as teaching school children, have been shown to improve willingness to perform CPR when asked.[61] Bystanders who have received formal CPR training within the last five years are more likely to perform CPR, than those without or no recent training.[62] Through further regular, targeted and widespread public education campaigns, bystanders can be more prepared to perform CPR when necessary.[59–60].

Limitations

This review was limited to studies that investigated factors that impacted B-CPR initiation and performance in the context of the emergency call, as we aimed for this review to show real-world responses associated with resuscitating a person in the community, rather than eliciting hypothetical responses. Components of CPR performance are not easy to ascertain in this environment, with CPR quality best measured using defibrillators or real-time feedback devices that can accurately measure depth, rate and recoil; none of which are usually available at the scene of the arrest. Future initiatives could aim to make these devices more widespread or modify existing technology, such as smartwatches, to be able to measure CPR metrics and provide feedback, enabling good quality B-CPR.

Our review focused on the interaction between the caller and call-taker through the EMS call, limiting the criteria to studies that analysed EMS call audio recordings and/or transcripts. As a result, the literature described here accounts for a subset of the literature regarding the factors which impact B-CPR performance. In addition, while the majority of the included articles aimed to identify barriers and facilitators to the initiation and performance of B-CPR, some studies gave little detail about each factor.

Conclusion

This scoping review demonstrated that the majority of the studies identified had focussed on the barriers to the provision of DA-CPR instructions and CPR initiation; with little information about the facilitators or barriers to ongoing B-CPR performance and maintenance of CPR quality. A better understanding of the facilitators and barriers to each phase of initiating and performing B-CPR can assist in the development of evidence-based strategies to motivate bystanders to perform high-quality CPR until the arrival of EMS.

Conflict of Interest declaration

JB is an Associate Editor of Resuscitation Plus.

CRediT authorship contribution statement

Emogene S. Aldridge: Methodology, Investigation, Data curation, Formal analysis, Writing – original draft, Project administration. **Nirukshi Perera:** Methodology, Investigation, Validation, Writing – review & editing. **Stephen Ball:** Methodology, Writing – review & editing. **Judith Finn:** Methodology, Writing – review & editing, Supervision. **Janet Bray:** Methodology, Writing – review & editing, Supervision.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resplu.2022.100290.

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REFERENCES

1. Panchal AR, Bartos JA, Cabañas JG, Donnino MW, Drennan IR, Hirsch KG, et al. Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation (New York, NY) 2020;142:S366–468.
2. Cummins R, Ornato J, Thies W, Pepe P. Improving survival from sudden cardiac arrest: The chain of survival concept. 1991.
3. Nolan J, Soar J, Eikeland H. The chain of survival. Resuscitation 2006;71:270–1.
4. Valenzuela TD, Roe DJ, Cretin S, Spaite DW, Larsen MP. Estimating effectiveness of cardiac arrest interventions : A logistic regression survival model. Circulation (New York, NY) 1997;96:3308–13.
5. Kurz MC, Bobrow BJ, Buckingham J, Cabanas JG, Eisenberg M, Fromm P, et al. Telecommunicator Cardiopulmonary Resuscitation: A Policy Statement From the American Heart Association. Circulation 2020;141:e686–700.
6. Fukushima H, Bolstad F. Telephone CPR: Current status, challenges, and future perspectives. Open Access Emergency Med 2020;12:193–200.
7. American Heart Association. Telecommunicator CPR (T-CPR) 2021 [Available from: https://cpr.heart.org/en/resuscitation-science/telecommunicator-cpr.
8. Rea TD, Eisenberg MS, Culley LL, Becker L. Dispatcher-assisted cardiopulmonary resuscitation and survival in cardiac arrest. Circulation (New York, NY) 2001;104:2513–6.

9. Riyapan Sattha, Lubin Jeffrey. Emergency dispatcher assistance decreases time to defibrillation in a public venue: a randomized controlled trial. Am J Emerg Med 2015;34:590–3. https://doi.org/10.1016/j.ajem.2015.12.015.
10. Song KJ, Shin SD, Park CB, Kim JY, Kim DK, Kim CH, et al. Dispatcher-assisted bystander cardiopulmonary resuscitation in a metropolitan city: A before–after population-based study. Resuscitation 2014;85:34–41.
11. Bray JE, Deasy C, Walsh J, Bacon A, Currell A, Smith K. Changing EMS dispatcher CPR instructions to 400 compressions before mouth-to-mouth improved bystander CPR rates. Resuscitation 2011;82:1393–8.
12. Kiguchi T, Okubo M, Nishiyama C, Maconochie I, Ong MEH, Kern KB, et al. Out-of-hospital cardiac arrest across the World: First report from the International Liaison Committee on Resuscitation (ILCOR). Resuscitation 2020;152:39–49.
13. Fukushima H, Imanishi M, Iwami T, Seki T, Kawai Y, Norimoto K, et al. Abnormal breathing of sudden cardiac arrest victims described by laypersons and its association with emergency medical service dispatcher-assisted cardiopulmonary resuscitation instruction. Emerg Med J 2015;32:314–7.
14. Alfsen D, Møller TP, Egerod I, Lippert FK. Barriers to recognition of out-of-hospital cardiac arrest during emergency medical calls: A qualitative inductive thematic analysis. Scand J Trauma Resusc. Emerg Med. 2015;23:70.
15. Schwarzkoph M, Yin L, Hergert L, Drucker C, Counts CR, Eisenberg M. Seizure-like presentation in OHCA creates barriers to dispatch recognition of cardiac arrest. Resuscitation 2020;156:230–6.
16. Riou M, Ball S, Williams TA, Whiteside A, Cameron P, Fatovich DM, et al. 'She's sort of breathing': What linguistic factors determine call-taker recognition of agonal breathing in emergency calls for cardiac arrest? Resuscitation 2018;122:92–8.
17. Abella BS, Aufderheide TP, Eigel B, Hickey RW, Longstreth Jr WT, Nadkarni V, et al. Reducing barriers for implementation of bystander-initiated cardiopulmonary resuscitation: a scientific statement from the American Heart Association for healthcare providers, policymakers, and community leaders regarding the effectiveness of cardiopulmonary resuscitation. Circulation 2008;117:704–9.
18. Chen K-Y, Ko Y-C, Hsieh M-J, Chiang W-C, Ma MHM. Interventions to improve the quality of bystander cardiopulmonary resuscitation: A systematic review. PLoS One 2019;14:e0211792-e.
19. Attard Biancardi MA, Spiteri P, Attard J, Debono M, Mifsud J, Farrugia AB, et al. CPR performance in lay people with telephone assisted CPR instructions – a prospective manikin-based observational study. Malta Medical J : MMJ 2020;32:4–23.
20. Arksey H, O'Malley L. Scoping studies: Towards a methodological framework. Int J Soc Res Methodol 2005;8:19–32.
21. Tricco A, Lillie E, Zarin W, O'Brien K, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): a checklist and explanation. Ann Intern Med 2018;169:467–73.
22. Open Science Framework. Factors that impact on bystander cardiopulmonary resuscitation performance during the emergency ambulance call for out-of-hospital cardiac arrest: a scoping review protocol 2021 [9 March 2022]. Available from: https://osf.io/v3d9m/.
23. Peters M, Godfrey C, McInerney P, Munn Z, Tricco A, Khalil H. Chapter 11: Scoping reviews (2020 version) 2020 [Available from: https://synthesismanual.jbi.global.
24. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. Syst Rev 2016;5:210–20.
25. Case R, Cartledge S, Siedenburg J, Smith K, Straney L, Barger B, et al. Identifying barriers to the provision of bystander cardiopulmonary resuscitation (CPR) in high-risk regions: A qualitative review of emergency calls. Resuscitation. 2018:N.PAG-N.PAG.
26. Culley LL, Clark JJ, Eisenberg MS, Larsen MP. Dispatcher-assisted telephone CPR: common delays and time standards for delivery. Ann Emerg Med 1991;20:362–6.
27. Deakin CD, Evans S, King P, Deakin CD, Evans S, King P. Evaluation of telephone-cardiopulmonary resuscitation advice for paediatric cardiac arrest. Resuscitation 2010;81:853–6.
28. Fukushima H, Panczyk M, Spaite DW, Chikani V, Dameff C, Hu C, et al. Barriers to telephone cardiopulmonary resuscitation in public and residential locations. Resuscitation 2016;109:116–20.
29. Dami F, Heymann E, Pasquier M, Fuchs V, Carron P-N, Hugli O. Time to identify cardiac arrest and provide dispatch-assisted cardio-pulmonary resuscitation in a criteria-based dispatch system. Resuscitation 2015;97:27–33.
30. Hauff SR, Rea TD, Culley LL, Kerry F, Becker L, Eisenberg MS, et al. Factors impeding dispatcher-assisted telephone cardiopulmonary resuscitation. Ann Emerg Med 2003;42:731–7.
31. Heward A, Donohoe RT, Whitbread M, Heward A, Donohoe RT, Whitbread M. Retrospective study into the delivery of telephone cardiopulmonary resuscitation to "999" callers. Emergency Med J 2004:233–4.
32. Ho AFW, Sim ZJ, Shahidah N, Hao Y, Ng YY, Leong BSH, et al. Barriers to dispatcher-assisted cardiopulmonary resuscitation in Singapore. Resuscitation 2016;105:149–55.
33. Lerner EB, Sayre MR, Brice JH, White LJ, Santin AJ, Billittier Iv AJ, et al. Cardiac arrest patients rarely receive chest compressions before ambulance arrival despite the availability of pre-arrival CPR instructions. Resuscitation 2008;77:51–6.
34. Lewis M, Stubbs BA, Eisenberg MS. Dispatcher-assisted cardiopulmonary resuscitation: time to identify cardiac arrest and deliver chest compression instructions. Circulation 2013;128:1522–30.
35. Linderoth G, Hallas P, Lippert FK, Wibr TI, Loumann S, et al. Challenges in out-of-hospital cardiac arrest - A study combining closed-circuit television (CCTV) and medical emergency calls. Resuscitation 2015;96:317–22.
36. Martinage A, Penverne Y, Le Conte P, San Miguel M, Jenvrin J, Montassier E, et al. Predictive Factors of Successful Telephone-assisted Cardiopulmonary Resuscitation. J Emergency Med (0736–4679) 2013;44:406–12.
37. Michiels C, Clinckaert C, Wauters L, Dewolf P. Phone CPR and barriers affecting life-saving seconds. Acta Clin Belg 2020:1–6.
38. Riou M, Ball S, Whiteside A, Bray J, Perkins GD, Smith K, et al. 'We're going to do CPR': A linguistic study of the words used to initiate dispatcher-assisted CPR and their association with caller agreement. Resuscitation 2018;133:95–100.
39. Siman-Tov M, Strugo R, Podolsky T, Rosenblat I, Blushtein O. Impact of dispatcher assisted CPR on ROSC rates: A National Cohort Study. Am J Emerg Med 2021;44:333–8.
40. Cheng-Yu C, Wei-Che C, Li-Heng T, Shang-Li T, Chen-Bin C, Chen-June S, et al. Impact of the caller's emotional state and cooperation on out-of-hospital cardiac arrest recognition and dispatcher-assisted cardiopulmonary resuscitation. Emergency Med J 2019;36:595–600.
41. Bång A, Herlitz J, Holmberg S. Possibilities of implementing dispatcher-assisted cardiopulmonary resuscitation in the communityAn evaluation of 99 consecutive out-of-hospital cardiac arrests. Resuscitation 2000;44(1):19–26.
42. Chocron R, Jobe J, Guan S, Kim M, Shigemura M, Fahrenbruch C, et al. Bystander Cardiopulmonary Resuscitation Quality: Potential for Improvements in Cardiac Arrest Resuscitation. J Am Heart Assoc 2021;10:1.
43. Clegg GR, Lyon RM, James S, Branigan HP, Bard EG, Egan GJ. Dispatch-assisted CPR: where are the hold-ups during calls to emergency dispatchers? A preliminary analysis of caller-dispatcher interactions during out-of-hospital cardiac arrest using a novel call transcription technique. Resuscitation 2014;85:49–52.
44. Hardeland C, Claesson A, Blom MT, Blomberg SNF, Folke F, Hollenberg J, et al. Description of call handling in emergency medical dispatch centres in Scandinavia: recognition of out-of-hospital cardiac arrests and dispatcher-assisted CPR. Scandinavian J Trauma, Resuscit Emergency Med 2021;29.

45. Langlais BT, Panczyk M, Sutter J, Fukushima H, Wu Z, Iwami T, et al. Barriers to patient positioning for telephone cardiopulmonary resuscitation in out-of-hospital cardiac arrest. Resuscitation 2017:163–8.
46. O'Neill JF, Deakin CD. Evaluation of telephone CPR advice for adult cardiac arrest patients. Resuscitation 2007;74:63–7.
47. Riou M, Ball S, Morgan A, Gallant S, Perera N, Whiteside A, et al. 'I think he's dead': A cohort study of the impact of caller declarations of death during the emergency call on bystander CPR. Resuscitation 2021;160:1–6.
48. Riou M, Ball S, Whiteside A, Gallant S, Morgan A, Bailey P, et al. Caller resistance to perform cardio-pulmonary resuscitation in emergency calls for cardiac arrest. Soc Sci Med 2020;256.
49. Leong PWK, Sieu-Hon L, Arulanandam S, Ng MXR, Yih Yng N, et al. Simplified instructional phrasing in dispatcher-assisted cardiopulmonary resuscitation - when 'less is more'. Singapore Med J 2021;62:647–52.
50. Linderoth G, Rosenkrantz O, Lippert F, Østergaard D, Ersbøll AK, Meyhoff CS, et al. Live video from bystanders' smartphones to improve cardiopulmonary resuscitation. Resuscitation 2021;168:35–43.
51. Nuño T, Bobrow BJ, Rogge-Miller KA, Panczyk M, Mullins T, Tormala W, et al. Disparities in telephone CPR access and timing during out-of-hospital cardiac arrest. Resuscitation 2017:11–6.
52. Pek JH, de Korne DF, Hannawa AF, Leong BSH, Ng YY, Arulan, et al. Dispatcher-assisted cardiopulmonary resuscitation for paediatric out-of-hospital cardiac arrest: A structured evaluation of communication issues using the SACCIA® safe communication typology. Resuscitation 2019;139:144–51.
53. Sanko S, Feng S, Lane C, Eckstein M. Comparison of Emergency Medical Dispatch Systems for Performance of Telecommunicator-Assisted Cardiopulmonary Resuscitation Among 9-1-1 Callers With Limited English Proficiency. JAMA Network Open 2021;4: e216827-e.
54. Sanko S, Kashani S, Lane C, Eckstein M. Implementation of the Los Angeles Tiered Dispatch System is associated with an increase in telecommunicator-assisted CPR. Resuscitation 2020;155:74–81.
55. Huang SK, Chen C-Y, Shih H-M, Weng S-J, Liu S-C, Huang F-W, et al. Dispatcher-assisted cardiopulmonary resuscitation: Differential effects of landline, Mobile, and transferred calls. Resuscitation 2020;146:96–102.
56. González BS, Martínez L, Cerdà M, Piacentini E, Trenado J, Quintana S. Assessing practical skills in cardiopulmonary resuscitation: Discrepancy between standard visual evaluation and a mechanical feedback device. Medicine (Baltimore) 2017;96:e6515.
57. Meischke H, Painter IS, Stangenes SR, Weaver MR, Fahrenbruch CE, Rea T, et al. Simulation training to improve 9-1-1 dispatcher identification of cardiac arrest: A randomized controlled trial. Resuscitation 2017;119:21–6.
58. Gram KH, Præst M, Laulund O, Mikkelsen S. Assessment of a quality improvement programme to improve telephone dispatchers' accuracy in identifying out-of-hospital cardiac arrest. Resuscitation Plus 2021;6:100096.
59. Strömsöe A, Andersson B, Ekström L, Herlitz J, Axelsson A, Göransson KE, et al. Education in cardiopulmonary resuscitation in Sweden and its clinical consequences. Resuscitation 2010;81:211–6.
60. Malta Hansen C, Kragholm K, Pearson DA, Tyson C, Monk L, Myers B, et al. Association of Bystander and First-Responder Intervention With Survival After Out-of-Hospital Cardiac Arrest in North Carolina, 2010–2013. JAMA 2015;314:255–64.
61. Böttiger BW, Bossaert LL, Castrén M, Cimpoesu D, Georgiou M, Greif R, et al. Kids Save Lives - ERC position statement on school children education in CPR.: "Hands that help - Training children is training for life". Resuscitation 2016;105:A1–3.
62. Matsuyama T, Scapigliati A, Pellis T, Greif R, Iwami T. Willingness to perform bystander cardiopulmonary resuscitation: A scoping review. Resusc Plus 2020;4:100043.