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Can a voice assistant help bystanders save lives? A feasibility pilot study chatbot in beta version to assist OHCA bystanders

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ABSTRACT

Objective: Evaluating the usefulness of a chat bot as an assistant during CPR care by laypersons.
Methods: Twenty-one university graduates and university students naive in basic life support participated in this quasi-experimental simulation pilot trial. A version beta chatbot was designed to guide potential bystanders who need help in caring for cardiac arrest victims. Through a Question-Answering (Q&A) flowchart, the chatbot uses Voice Recognition Techniques to transform the user's audio into text. After the transformation, it generates the answer to provide the necessary help through machine and deep learning algorithms. A simulation test with a Laerdal Little Anne manikin was performed. Participants initiated the chatbot, which guided them through the recognition of a cardiac arrest event. After recognizing the cardiac arrest, the chatbot indicated the start of chest compressions for 2 min. Evaluation of the cardiac arrest recognition sequence was done via a checklist and the quality of CPR was collected with the Laerdal Instructor App.
Results: 91% of participants were able to perform the entire sequence correctly. All participants checked the safety of the scene and made sure to call 112. 62% place their hands on the correct compression point. A media time of 158 s (IQR: 146–189) was needed for the whole process. 33% of participants achieved high-quality CPR with a median of 60% in QCPR (IQR: 9–86). Compression depth had a median of 42 mm (IQR: 33–53) and compression rate had a median of 100 compressions/min (IQR: 97–100).
Conclusion: The use of a voice assistant could be useful for people with no previous training to perform de out-of-hospital cardiac arrest recognition sequence. Chatbot was able to guide all participants to call 112 and to perform continuous chest compressions. The first version of the chatbot for potential bystanders naive in basic life support needs to be further developed to reduce response times and be more effective in giving feedback on chest compressions.

1. Introduction

About 70% of cardiac arrests (CA) occur in residential areas, with approximately 58% being witnessed by bystanders in Europe [1].

Immediate and appropriate cardiopulmonary resuscitation (CPR) by bystanders can directly influence patient outcomes after out-of-hospital cardiac arrest (OHCA), improving survival by two to four times [2-4]. Training population in basic life support (BLS) is supported by the scientific community and is reflected in published guidelines [5]. However, there are barriers that may hinder access to BLS training (economic, time availability or place of residence) [6-9].

According to the evidence, bystanders initiate resuscitation maneuvers in 58% of cases in Europe (ranging from 13% and 82% across countries) [1]. Therefore, it is important to analyze the usefulness of tools to improve bystander-initiated CPR rates.

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In recent years, the applicability of new technologies to the health care field has been extensively studied. In this regard, virtual assistants have been developed for the management of chronic pathologies such as diabetes [10-12] or the training of clinical skills such as communication [13].

Related to CPR care, the impact of the use of mobile apps on CPR quality (considering chest compressions and AED use) has been analyzed [14,15]. Although these apps could have a positive influence on the quality of resuscitation performed by untrained persons, it requires prior motivation by the bystander. If the potential rescuer is afraid of not knowing what to do or of hurting victim, CPR could be delayed until the emergency services arrive, with the consequent repercussions on the chances of survival and outcomes. Therefore, if in the case of witnessing an OHCA it was possible to use an assistant to guide the action, higher rates of bystander-initiated resuscitation could be achieved, and resuscitation could be performance with higher quality and earlier.

For these reasons, the aim of the present study is to evaluate the usefulness of a chat bot as an assistant during CPR by laypersons.

2. Material and methods

2.1. Participants

Twenty-one university graduates or university students naive in basic life support took part in the present pilot trial. This condition was checked by the research team twice: at the time of the invitation to participate in the study and before the practical test. On both occasions, the question was asked openly, and the response was recorded on the data collection sheet for the record.

All of them were previously informed about the aim of the study and we explained in advance what participation consisted of.

2.2. Design

We develop a Quasi-experimental simulation pilot study with a convenience sample in September 2021 in Faculty of Sports and Educational Sciences. For this study, we designed and created a chatbot to assist OHCA first responders.

The practical test consisted of a simulated scene of OHCA where participants had to act as a first responders following the guidance of chatbot. Before the practical test, the participants were given the following information: the simulation scenario consisted of witnessing a person suddenly fall to the floor, material inside the simulation scenario (manikin and chatbot), the chatbot would help them in the assistance of the victim and would be triggered by the phrase "I need help". No more instructions or training were given before the practical test.

Performance was assessed by means of a check list which include the steps of basic life support sequence: safety, check response, open the airway, check breathing, call the emergency services, chest compressions (CC) and time to start CC. Furthermore, quality of CC was assessed by the Laerdal Instructor App for smartphone.

2.3. Materials

Chatbot or Conversational Assistant aims to guide the user through a Question-Answering (Q&A) flowchart for the correct exercise of the primary CPR assistance maneuver. Conversational Assistant uses Voice Recognition Techniques to obtain the user's audio and transforms it into text. Once this transformation is done, it performs a text processing stage that, by means of Machine and Deep Learning algorithms, can understand, and process the corresponding answer. The chatbot is activated when it recognizes the phrase "I need help". It then asks a question to confirm the need for help and guides the conversation through each step of the basic life support algorithm. Thus, chatbot was used firstly to recognize CA, by giving instructions about how to check response and breathe. After CA is confirmed, chatbot guides the CC performance (correct hands position, CC depth, CC rate). A flowchart of the conversation process and the interpretation of the responses is included in Annex 1.

For simulation scenes we used a manikin Little Anne (Laerdal) and the Instructor App (Laerdal) to record quality of chest compressions.

2.4. Variables

We registered age and sex of each participant.

Steps of BLS sequence were categorized as dichotomous qualitative variables.

The quality of CC was recorded quantitatively, using the Laerdal Little Anne manikin with the Instructor App, configured according to the 2021 international BLS recommendations (depth: 50–60 mm; rate: 100–120 compressions/min). The variables included were: global QCPR (%), time to start CC in seconds (recorded since the chatbot was triggered to first chest compression performed), mean CC depth (mm), CC with correct release (%), CC with correct depth (%), CC with correct rate (%) and mean CC rate (c/min).

2.5. Statistical analysis

Continuous variables were described by measures of central tendency (median) and dispersion (interquartile range Q1 - Q3). Categorical variables were described as absolute and relative frequencies.

2.6. Ethics

All participants were informed about the aims and study protocol and provided written informed consent. Participation was voluntary and no personal incentive for participation was given. The study respected the Helsinki Declaration and was approved by the Faculty of Education Sciences and Sports Ethics Committee (code 16–072).

3. Results

Twenty-one participants were involved in the present pilot trial. The median age of the sample was 25 years (22–28).

The skills for the OHCA recognition are shown in Fig. 1. Ninety-one percent of them were able to perform the entire sequence correctly, as they checked the victim's consciousness and breathing. No participant opened the airway to check for breathing and only 72% brought their face close to the victim's face. All participants checked the safety of the scene and made sure to call 112. Sixty-two percent placed their hands on the correct compression point. A median time of 158 s (IQR: 146–189) was needed for the whole process.

The percentages of participants with CPR quality criteria (≥ 70% value) are shown in Fig. 1. Thirty-three percent of participants achieved high-quality CPR, 86% achieved quality chest release, 38% did so in depth of compressions and only 5% in compression rate. On the other hand, 24% achieved a mean depth between 50 and 60 mm and 62% achieved a mean rate between 100 and 120 c/min.

CPR skills are shown in Fig. 2. The quality of CPR reflects a median of 60%, although with a large dispersion (IQR: 9–86). Correct depth was the parameter with the worst values (6%) and present a large dispersion (IQR: 0–97). The mean compression depth was 42 mm (IQR: 33–53). The correct rate was more stable with a median of 52% (IQR: 45–59),

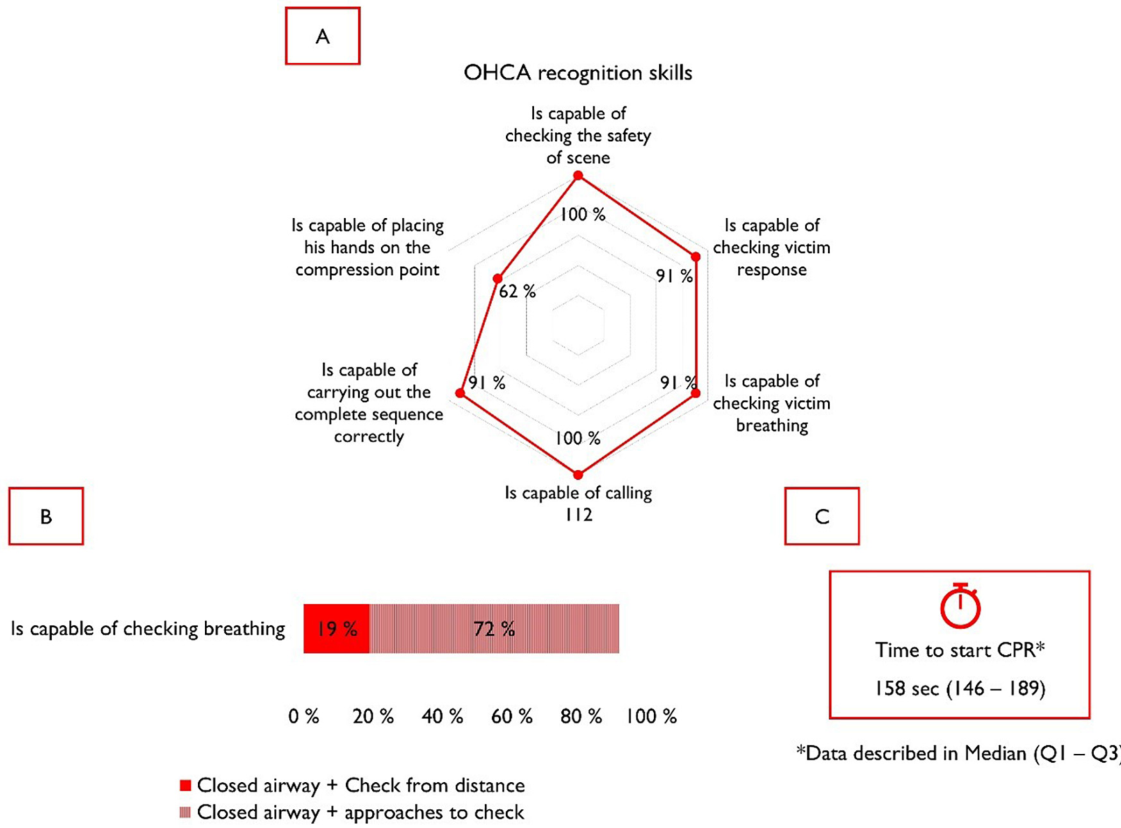

Fig. 1. A. Results of skills for the OHCA recognition; B. Results of skills for the checking breathing; C. Results of time to start CPR.

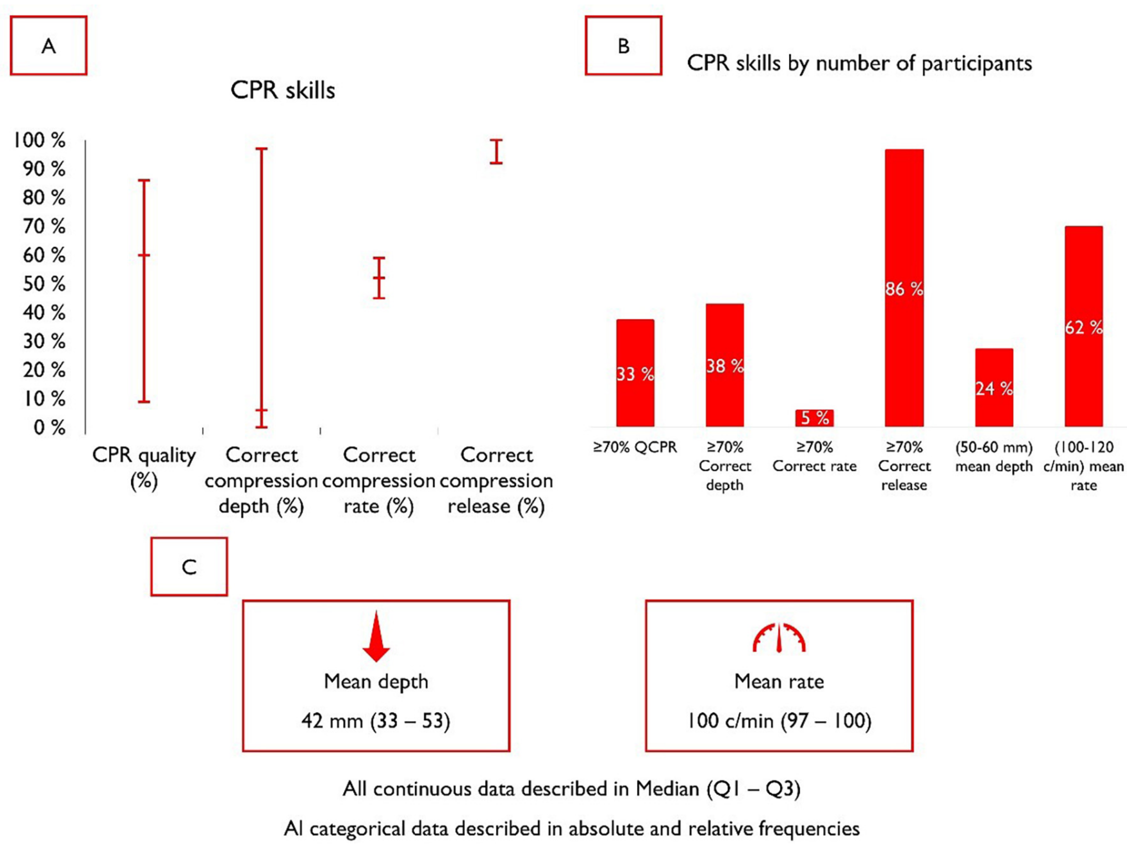

Fig. 2. A. Results of CPR skills values; B. Results of CPR skills by number of participants; C. Results of mean depth and mean rate variables.

as was the mean rate [100 compressions/min; (IQR: 97–100)]. Correct release was the best value with a median of 100% and an interquartile range of (IQR: 92–100).

4. Discussion

This study evaluates the usefulness of a novel interactive Artificial Intelligence app based on natural language processing algorithms. Although the usefulness of virtual assistants in the health field has been studied, to date no similar tool had been designed to assist witnesses of OHCA.

In recent years, the implementation of teleoperator-assisted CPR has led to an increase in CPR bystander rates. In Europe, 91% of bystander CPR was performed at the direction of an emergency teleoperator. This high percentage suggests limitations in the skills or confidence of citizens in responding to CA. However, in Europe, data indicate that almost one in three (31%) OHCA are not treated until the arrival of EMS [1]. In this study, using a voice assistant, 91% of participants got the whole sequence correct and all of them called 112 and started CC. Furthermore, the quality of the application of the recognition sequence achieves no lower results than university students who received 150 min of BLS training [16].

All this was performed in 158 s on median, in a range of 146–189 s. This amounts to a time of between 2.5 and 3 min until the start of compressions and alert to EMS, reducing the probability of survival by about 30% [17]. In the study by Dong et al., which combined the use of an app that provided quality feedback with telephone instructions provided by medical personnel, the time to the start of compressions was 140 s, which we consider could still be improved [18].

One in three participants performed high quality CPR. Moreover, 62% of participants had a correct mean rate and 24% had a correct mean depth. The percentage of participants performing high quality CPR is lower compared to people receiving training, which is to be expected as the participants had never performed CPR before and had never received training in this regard [16]. On the other hand, the ERC encourages the implementation of technologies that improve CPR bystander rates and, therefore, survival [17]. Getting all bystanders to start CPR and one third of them to do it with high quality is a good start for the initiation of voice assistants in CA.

The quality of CPR skills recorded when using the voice assistant appears to be lower than that obtained in other studies in which previous training is conducted [16,19,20]. However, CPR skills do appear to be better than those obtained when using other mobile applications that provide real-time feedback [14].

Obtaining a median CPR quality of 60% is interesting as a starting point, although the wide dispersion of the results suggests the need to implement improvements in feedback during CPR. However, the usefulness of the voice assistant may be a necessity in the future of society. Today, most smartphones, tablets and laptops have voice assistants that are quick and easy to activate. If untrained citizens are aware of this utility in case of an emergency, the voice assistant could guide them to activate the chain of survival. In this case, all participants managed to perform CPR and one in three did so with high quality, so it appears to be a potentially useful tool if improvements are made.

Our study has some limitations. The test was carried out under simulated conditions, so results are probably not the same as those that would be obtained in a real situation. The convenience sample were people who have studied or are studying at university, which implies some selection bias that would limit the generalization of results. Moreover, this pilot study is the first experience using this tool (chatbot) which is still in the development stage. Nevertheless, the results of its use indicate that it seems interesting to continue improving the chatbot and to evaluate it on a larger sample. In addition, this is a usability study not a comparison study and it represents the first stage of this project. Comparison of this device with other types of assistance during cardiac arrest cannot be determined in the present research design. Our aim is to conduct a second stage comparison study, in which we will analyze the differences between directly calling 112 and following dispatcher instructions and using both, the chatbot and 112 call.

Future research related to the voice assistant should be directed towards improving the limitations found, with the aim of improving the results obtained. Although it is a useful tool that can help a BLS naive person to act, it is possible that changes in the assistant could lead to better results and less dispersion. The assistant needs to guide the participant more quickly to decrease the time to first chest compression. Clearer and more specific commands may improve the quality of the recognition sequence, hand placement or compression depth. Setting the metronome to 110 c/min instead of 100 c/min may also improve the quality of the compression rate.

5. Conclusions

In conclusion, the use of a voice assistant could be useful for people with no previous training to perform the life support sequence completely and correctly. Furthermore, although the CPR skill values are very dispersed, the voice assistant managed to guide all participants to chest compressions and one in three participants did so with high quality. The first version of the chatbot for potential bystanders naive in basic life support needs to be further developed to reduce response times and be more effective in giving feedback on chest compressions.

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CRediT authorship contribution statement

Martín Otero-Agra: Writing – original draft, Investigation, Formal analysis, Data curation. **Cristina Jorge-Soto:** Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Óscar J. Cosido-Cobos:** Software. **Jorge Blanco-Prieto:** Software. **Cristian Alfaya-Fernández:** Investigation. **Enrique García-Ordóñez:** Investigation. **Roberto Barcala-Furelos:** Writing – review & editing, Supervision, Resources, Project administration, Methodology.

Declaration of Competing Interest

All the authors declare that there is no conflict of interest.

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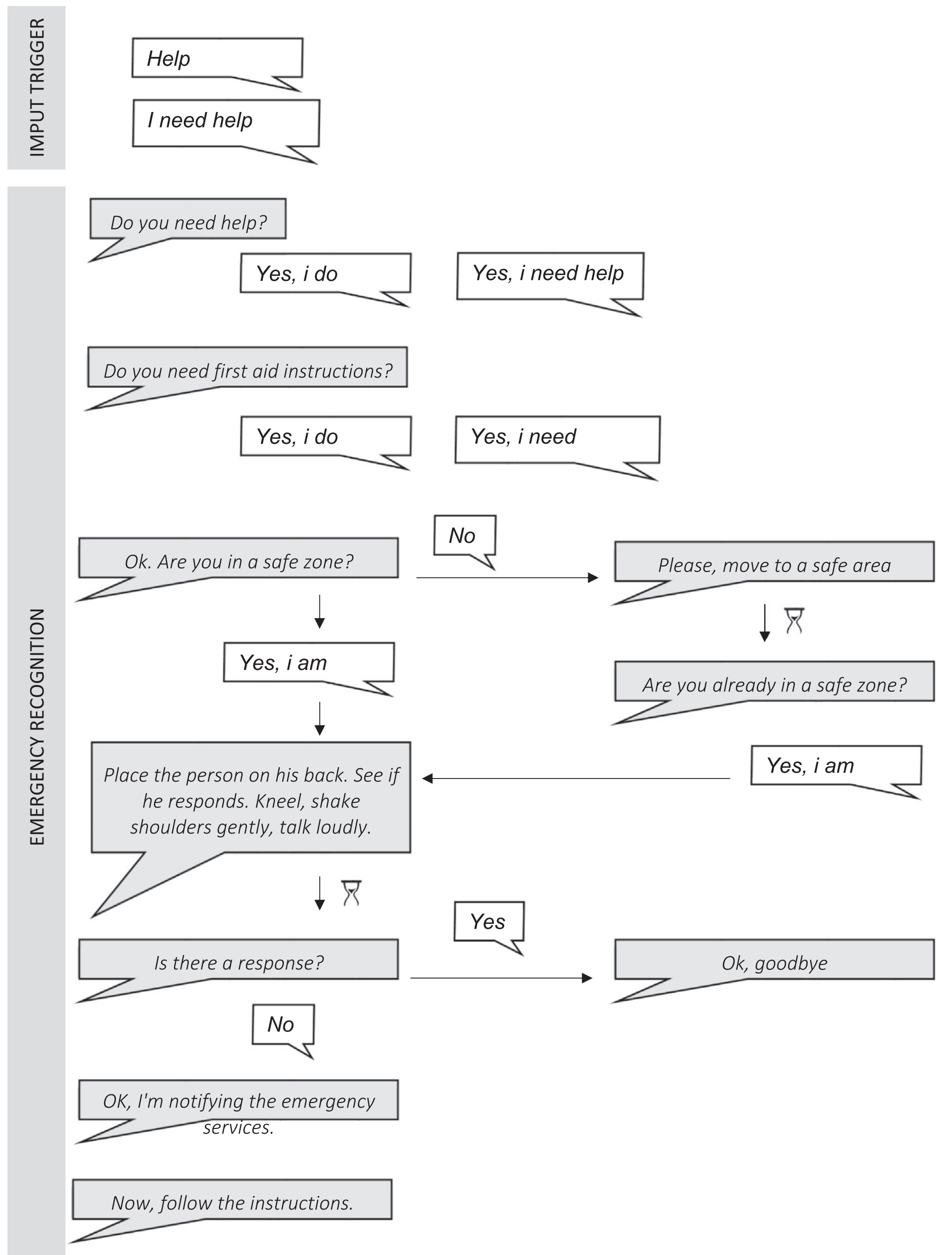
None.

Appendix A. Chatbot conversation flowchart



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