bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Influencing factors of telephone-cardiopulmonary resuscitation in China: a qualitative exploration based on managerial perspectives

Xuehua Zhu[1,2], Li Gui[1]*, Xiaoge Xie [3], Yin Lin [2]

[1] School of Nursing, Second Military Medical University, Shanghai, China

[2] School of Nursing, Zhejiang Chinese Medical University, Hangzhou, China

[3] School of Nursing, Wenzhou Medical University, Wenzhou, China

Xuehua Zhu, RN, MM

Li Gui, RN, PhD

Corresponding author: Li Gui, RN, PhD, School of Nursing, Second Military Medical University, 800 Xiangying Rd, Shanghai, 200433,China (guili2000@qq.com).

E-mail: Xuehua Zhu:snow_zxh@163.com, Li Gui: guili2000@qq.com, Xiaoge Xie: 251258893@qq.com，Yin Lin：527156534@qq.com

Abstract

Background: Telephone-cardiopulmonary resuscitation (T-CPR) has been proven to systematically improve bystander CPR implementation and thus improve the survival rate of out-of-hospital cardiac arrest (OHCA) patients on a large scale. However, China has a lower proportion of cities that provide T-CPR than other countries. To promote the implementation of T-CPR in China, our study is based on managerial perspectives (Health Bureau, Fist-aid Center and other management personnel) who will play a key role in carrying out TCPR, and through a qualitative study to explore the factors affecting the providing of TCPR, especially finding out the possible obstacles, so as to promote the implementation of TCPR and play a role in promoting human health.

Methods: The semi-structured interview was conducted with managers by phenomenological research method in the qualitative study, and the data was sorted out by Nvivo 10.0 qualitative analysis software, and the data was analyzed by Colaizzi analysis to extract the theme.

Results: The influencing factors of T-CPR in China were mainly divided into six dimensions: bystander factors, dispatcher factors, dispatching system factors, legal factors, guiding factors and financial factors.

Conclusion: It is urgent to promote the implementation of T-CPR in China. We can promote it by strengthening the training of bystanders in CPR knowledge and skills, enhancing the awareness of first aid in the whole society, developing T-CPR guidance process suitable for Chines national conditions, building an intelligent pre-hospital emergency system, promoting the legislation of first aid exemption, and providing financial support from various channels.

Keywords: Bystander CPR; Telephone-CPR; Cardiopulmonary resuscitation ; Out-of-hospital cardiac arrest; Qualitative research

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

1. Introduction

Out-of-hospital cardiac arrest (OHCA) is the most urgent and dangerous public health issue in the world [1-3]. Modern medicine has fully proved that 4 to 6 minutes after cardiac arrest is the golden time for rescue, but it is difficult for ambulances to arrive at the scene in the golden time. Therefore, whether the public implement cardiopulmonary resuscitation (CPR) or not and the quality of CPR have a significant impact on the survival rate of OHCA patients. Because the witnesses are often non-professional medical personnel, they will not really administer effective CPR for patients with cardiac arrest because they are not confident in their own CPR skills, afraid of the implementation of mouth-to-mouth artificial respiratory infectious diseases, panic, and have not learned CPR [4-5]. So that patients miss the best time to rescue and lead to serious consequences, bringing heavy burdens to society and families.

In order to increase bystander cardiopulmonary resuscitation (B-CPR) and to improve patient outcomes, American heart association (AHA) Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (ECC) clearly point out that the first witnesses who have never received CPR training or who have received training but failed to successfully initiate CPR in the first time should be instructed by dispatchers through telephone to implement CPR (T-CPR) [6]. T-CPR enables some first-time witnesses who have never received CPR training to implement CPR under the guidance of the dispatcher's telephone, thus making it possible for more OHCA patients receive early CPR.

Since telephone-assisted cardiopulmonary resuscitation can significantly improve the willingness and quality of witnesses to perform CPR, T-CPR has been carried out in many countries, such as the United States, Britain, Japan, Sweden, Canada, Switzerland and Norway [7-12]. But T-CPR is seldom carried out in China, only in a few cities such as Suzhou and Foshan. China, a country with 4/1 of the world's population, in order to improve its popularity of T-CPR and the success rate of on-site rescue, and to reduce the mortality and disability rate after cardiac arrest, our study is based on managerial perspectives (Health Bureau, Fist-aid Center and other management personnel) who will play a key role in carrying out TCPR, and through a qualitative study to explore the factors affecting the providing of TCPR, especially finding out the possible obstacles, so as to promote the implementation of TCPR and play a role in promoting human health.

2. Participants and methods

2.1 Participants

Using purposive Sampling method, the managers were recruited from health bureau and first-aid Center as participants. The sample size is based on the principle of information saturation [13-15]. Finally, a total of 10 managers consented to participate in the study. The inclusion criteria were: (1) managers from health bureau and first-aid Center aged 18-60, (2) worked in this management for more than 2 years, (3) could understand and communicate in Chinese, (4) agreed with the interviewees. The exclusion criteria were: (1) mental disorders and/or cognitive impairment, (2) unable to complete the study due to physical condition, (3) unable to perform CPR due to physical disability or other reasons. The general information of the participants is shown in table 1.

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Table 1 General information of the participants

Number	Gender	Age (years)	Working time (years)	Education	Marital status	Profession title	Graduation major	position
A	Male	49	27	Bachelor degree	Married	Senior	Clinical medicine	Deputy director of first-aid center
B	Female	42	25	Bachelor degree	Married	Middle	Health management	Director of first-aid center
C	Male	40	20	Bachelor degree	Married	Associate senior	Clinical medicine	Chief of training department of first-aid center
D	Male	32	9	Bachelor degree	Married	Middle	Computer science	Chief of dispatching department of first-aid center
E	Female	45	25	Bachelor degree	Married	Middle	Health management	director of medical affairs under Provincial Department of Public Health
F	Male	35	10	Bachelor degree	Married	Middle	Preventive medicine	Deputy director of maternal and child Health Service
G	Male	28	2	Bachelor degree	Single	Middle	Computer science	Deputy director of Red Cross ambulance training center
H	Male	39	19	Bachelor degree	Married	Middle	Economic management	Chief of the Red Cross relief and rescue department
I	Male	43	21	Doctoral degree	Married	Senior	Clinical medicine	Director of first-aid center
J	Male	52	29	Bachelor degree	Married	Associate senior	Clinical medicine	Director of emergency office of the commission for health and discipline

2.2 Methods

2.2.1 Study methods

To conduct in-depth interviews with managers about their perception of telephone-assisted cardiopulmonary resuscitation and the factors affecting T-CPR in China, especially the obstacles. A phenomenological method as a qualitative Research was used in this study. Data were collected by using semi-structured interviews through face-to-face or by telephone.

2.2.2 Outline of the interview

In order to avoid omission and thus affect the integrity of the data, an interview outline was designed according to the previous literature review and research purposes. It mainly included the following contents:

1. Introduction: Introduced the research team members and the project, asked for consent,

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

and signed the informed consent.

2. Interviewee self-introduction: age, marital status, educational level, health status; graduation major, occupation, title, position; working time, holding the post time, mainly engaged in work.

3. Interview contents: (1)What are the advantages and disadvantages of on-site cardiopulmonary resuscitation (CPR) and telephone-assisted cardiopulmonary resuscitation (T-CPR) for the publics? (2) Do you think T-CPR is useful for the publics? Why? What factors will affect the public's perception of the usefulness of T-CPR? (3) Do you think T-CPR is easy to use for he publics? Why? What factors will affect the public's perception that T-CPR is easy to use? (4)Which way do you think is more suitable for the publics, such as audio phone guidance, video phone guidance and mobile phone software guidance? Which way is more likely to implement for the managements? Why? Are there any other suggestions for guidance? (5) Do you think the publics will accept T-CPR? Why? Do you think T-CPR will be accepted by the management personnels? Why? Please specify your views on T-CPR and the reasons for acceptance or non-acceptance of T-CPR. What factors will affect the acceptance of T-CPR by the publics and managements? (6)What's your opinion on legal or policy support for public implementation of CPR or T-CPR? (7) What reasons do you think that our country has not carried out T-CPR systematically? What other factors will affect the implementation of T-CPR? Which mode do you think is most suitable for carrying out T-CPR in China? Please talk about the suggestions to promote implementation of T-CPR in China.(8)What difficulties do you think there will be in carrying out T-CPR as a management department?

4. Express our thanks.

2.2.3 Data collection

Semi-structured in-depth interviews were used to collect data [16] from April 2016 to July 2016.We choose a quiet place for the interview and it was conducted in the free time of the interviewees. The purpose and significance of this study were explained to the participants before the interview. After obtaining the formal consent of them, the informed consent was signed. Because we needed to record the whole interview process, we explained the role of recording to the participants in advance and got their permissions.

During the interview, we carefully observed the interviewees and recorded their expressions, facial expressions, etc. The interview time was about 30 to 40 minutes for each participant. The privacies of the participants were protected, and the name was replaced by the code.

2.2.4 Data analysis

Within 24 hours after the interview, the recording was transcribed into text, and the participants' non-verbal behaviors (expressions, movements, etc.) and their basic personal information were recorded [17].In this study, QSR Nvivo 10.0 qualitative analysis software and Colaizzi's descriptive phenomenological method[18-19] were used to analyze the data. The stages are: (1) familiarized with the data, by reading through all the participant accounts several times; (2) identified all statements in the accounts that were of direct relevance to the phenomenon under investigation; (3) identified meanings relevant to the phenomenon that arose from a careful consideration of the significant statements;(4) clustered the identified meanings into themes that were common across all accounts;(5) wrote a full and inclusive description of the phenomenon,

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

incorporating all the themes produced at step 4;(6) condensed the exhaustive description down to a short, dense statement that captured just those aspects deemed to be essential to the structure of the phenomenon;(7) returned the fundamental structure statement to all participants to ask whether it captured their experience, then went back and modified earlier steps in the analysis in the light of this feedback.

2.2.5 Quality control

Pre-interview is used to train the researcher's interview and recording skills. In the process of research, the principle of voluntariness and confidentiality was followed. The interviewers used appropriate language and non-critical attitude to encourage the interviewees to express themselves and avoided giving any hints to them.The interview materials were coded and categorized one by one, and the interviewees own language is used as far as possible.

2.2.6 Ethical approval

Ethical approval for the study was obtained from the ethics committee of Wenzhou medical university, Zhejiang Province, China.

3. Findings

Through the analysis and refinement of interview data, six influencing factors of T-CPR in China were finally formed: bystander factors, dispatcher factors, dispatching system factors, legal factors, Guiding factors and financial factors.

3.1 Bystander factors

3.1.1 Different knowledge levels of bystanders

T-CPR implementation is influenced by the educational levels of bystanders. For example, interviewee E said, 'If he or she (refers to bystanders) has a higher level of knowledge, then our dispatcher's guidance will be much better, and its effectiveness may be higher.' Respondent F: 'The caller's knowledge and education are also related. If he or she doesn't understand what we're talking about, it may be difficult to implement T-CPR.'

3.1.2 Weak awareness of first aid and low level of cardiopulmonary resuscitation of bystanders

At present, there is still a big gap in the awareness and level of first aid among Chinese residents compared with the developed countries. Nationals do not attach importance to the basic first aid knowledge. All of those will affect the implementation of T-CPR.As respondent B said: 'Our country is, in my own city, uh (pause...), our common people have little knowledge of first aid, such as cardiopulmonary resuscitation. In this situation, the effect of T-CPR will be affected.' Interviewee E said: 'You know, it is obviously related to whether he or she has received the propaganda of first aid skills, especially the learning of first aid skills.' 'To tell the truth, I think CPR is a little abstract, and it's hard to make it clear on the phone. If someone hadn't received any training in CPR, I don't think he could implement TCPR.'(Respondent G). And respondent H said: 'At present, some people do not accept CPR. They always feel that the danger is far away from them and doesn't matter to them. Their awareness of first aid is weak.'

3.1.3 Volatile emotions of bystanders

Bystanders will feel fear and dread when they encounter such sudden situations, which will affect them to implement T-CPR. For example, respondent E said, "In the process of T-CPR, sometimes it is necessary to calm the caller constantly. Some people can compression but dare not.

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

They are fear and afraid of being tired. So in this process, the instructor should give them some encouragement and comfort according to the different situations, otherwise it will affect the implementation of TCPR.' Respondent I said: 'In such a sudden situation, some callers are unstable and will be more anxious. Sometimes on the phone we will tell them what to do and how to do, but they don't cooperate. They only ask you to send an ambulance as soon as possible. They don't listen to the dispatcher at all. They don't understand why they need to rescue the sudden cardiac arrest (SCA) patients.'

3.2 Dispatcher factors

3.2.1 Lack of dispatchers

Because of the special nature of work, the particularity of working time, high recruitment requirements for recruiting, difficult promotion and low salary, the dispatchers are lacking and difficulty to recruit. As respondent B said: 'In our country, it is very difficult to recruit practitioners in pre-hospital first aid when there is a relative shortage of licensed doctors and some general hospitals are difficult to recruit practitioners. I think it's also a waste of resources. The primary health centers can recruit practicing assistant doctors instead of practicing doctors. At present, we are very short of personnel.' Respondent D said: 'The work of dispatcher is usually toilsome and on three shifts. Many dispatchers are non-regular workers, not well-paid and unstable. So many people are reluctant to work as dispatchers.' Respondent E expressed the similar meanings: 'Now dispatchers are mostly casual workers. Poor pay can't recruit excellent persons and can't keep old employees.'

3.2.2 Lack of professional skills of dispatchers

Because of the difficulty of personnel recruitment, many first-aid centers can only reduce the recruitment requirements, so the first aid knowledge and skills of dispatchers in many dispatching posts are not high, which also affects the implementation of T-CPR. Respondent B said: "Many dispatchers are temporary now. Not many of them have a real medical background.' 'In our city, non-medical workers are answering the emergency calls now. They don't have medical knowledge. If he or she makes a descriptive mistake, the consequence is that, as you know, it's not necessarily good for the person's rescue. He or she may be the defendant.' （Respondent C）. Interviewee D said: 'We also suggest that dispatchers should have medical education background. Even if they graduate from a health school, it's not the same. But in fact, many operators do not have this background (helpless laughter).'

3.3 Dispatching system factors

3.3.1 Lack of dispatching equipment

Managers of emergency centers that had implemented T-CPR said that the dispatching equipment they used was imported from abroad and was not localized. So in some cases is not suitable for China. For example, respondent B: 'We need to establish a more standardized way of guiding. This medical priority dispatch system (MPDS) is relatively mature in the United States, but it needs to be localized if it is used in China. After all, MPDS is made in accordance with the national conditions of the United States.' 'Our T-CPR is zero-based. Certainly we still need to learn from the other countries. After learning from them, we must adjust it according to our own situation and form our own first aid system for implementing T-CPR.' （Respondent G）.

3.3.2 Lack of standard procedures of dispatch

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

The lack of unified, simple and standardized flow chart to guide the dispatching process is also one of the important reasons that affect the implementation of T-CPR. As respondent C said: 'I think the most important thing is how to guide and find a more suitable path for our country to do it.' Respondent I said: 'We feel that such an approach (T-CPR) must be very meaningful. That is to say, the telephone guidance is very meaningful, but the key of T-CPR is to standardize rather than to say that it is a purely subjective guidance. There must be a difference in the guiding effect between the two. This requires us to design a simple and standardized flow chart to guide the bystander to implement CPR.'

3.4 Legal factors

Relevant managers said that there is no relevant law to protect dispatchers from disputes in telephone guidance. The dispatchers will have some concerns when they conduct telephone instruction, and their rights and interests are not guaranteed at all, so they are reluctant to implement T-CPR.As respondent B said, 'Uh... Legal protection is necessary. Ha ha ha (laughing...). It's not to say dare or not dare. If there is no legal protection, the instructors will always take risks. It's not good for them.' Interviewee G said: 'I think the law is very necessary. If we really want to implement T-CPR, we must have the corresponding regulations and safeguards. Otherwise, who are responsible for the problems? Are the dispatchers? Nobody wants to take this responsibility. In the end, nobody can make that claim.' 'If there is no legal protection, the dispatchers are certainly worried about to implement T-CPR.Is it necessary for dispatcher to assume responsibility if he or she instructs bystanders to do CPR in case of problems?'

（Respondent I）.

3.5 Guiding factors

Different guiding methods, whether the guiding software is useful or easy to use will significantly affect the implementation of T-CPR. It is crucial for bystanders to implement T-CPR in the first time. As respondent F said, "I think the most important two aspects that affect the implementation of T-CPR are the cultural quality of the public and the methods & convenience of T-CPR guidance. For example, when someone in the mall falls down suddenly, the first witness can turn on a T-CPR video very conveniently and quickly. I think it is a good guiding methods.' Respondent A said, 'At present, young people are more likely to accept mobile APP guidance. The most important thing is to be able to let bystanders find and open it quickly. If the bystander can download the video or play the downloaded video or dial the video phone quickly, the video and animated APP are more intuitive and definitely better than the separate audio. It is not complicated to implement CPR by bystanders. As long as he has read or studied or understood it, he will be able to do it. So, pure audio may be not enough. But if there's no video or the bystanders can't play it in time, audio can also play a certain role.'

The coexistence of various guiding methods can promote the implementation of T-CPR.As respondent B said: 'Comprehensive guidance can be fully achieved. For example, as Wechat is widely used nowadays, we can use Wechat to supplement some deficiencies in informatization. If some callers can't tell their address clearly, they can scan the WeChat official account of the dispatching center and send the address directly to them. At the same time, this Wechat official account can provide video of CPR to guide bystanders to rescue the OHCA patients. I think this is

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

also a very good method for T-CPR.' Respondent A said: 'I think the method of guidance, dispatcher telephone guidance should be a main guidance. But it can be combined by various methods, including mobile phone software guidance, video guidance and so on. As long as there are many ways to guide, T-CPR will surely develop rapidly.' 'I think if our country want to do this work, it should coexist in many ways which will be suitable for different age groups and be accepted by different age groups. Because most of the elderly do not have smart phones, they are easy to accept the dispatcher's telephone guidance. Young and middle-aged people are more likely to use mobile APP or visual telephone. Mobile APP method can give someone the chance to learn CPR in their spare time. A variety of guidance methods can complement each other. (Respondent H) .

3.6 Financial factors

The amount of capital investment obviously affects the implementation of T-CPR. The software development of T-CPR, the allocation of instructors, the improvement of dispatching guidance system and the training of bystanders' CPR skills all need sufficient financial support. For example, respondent B said, 'T-CPR can not be carried out without the financial support of the government. The increase of personnel and the improvement of informationization need financial support. In fact, the price of developing such a system is relatively high.' Respondent F said: 'If the project is to be carried out, the management will have to consider how much it will cost, how much economic and social benefits it will bring, and whether the current financial revenue can support it.' 'The key to the implementation of T-CPR is the need for input, input of labour, capital and materials, which is the main problem.' (Respondent I) .

4. Discussion

4.1 Strengthen the training of bystanders in cardiopulmonary resuscitation knowledge and skills, enhance their awareness of first aid, which will make the public accept T-CPR easily.

Our study reveals that different cultural levels of bystanders will affect the effect of T-CPR. If the bystander does not understand the guidance, it is obviously impossible to implement T-CPR. In fact, it has been 33 years since China implemented free nine-year compulsory education in six-year primary schools and three-year junior middle schools. The Chinese people, especially the adults under the age of 60, already have the basic knowledge for implementing T-CPR. But in the telephone, especially in the traditional audio phone, it is difficult to understand how to do when the OHCA occurs. If we strengthen the training and propaganda of relevant knowledge, so that the bystanders have a certain basis, it is obviously easy to understand and accept and begin to implement T-CPR.For the training of CPR knowledge and skills, China has attached great importance under the leadership of the Red Cross Society of China after the May 12 Wenchuan earthquake in Sichuan province in 2008. However, compared with the huge population of nearly 1.4 billion in China, the proportion of training is still very low and uneven, ranging from 1.0% to 11.8%.There is a huge gap between China and the United States and other countries [20-22]. Therefore, on the one hand, we still need to continue to increase the training intensity and breadth of CPR, on the other hand, it is urgent to carry out T-CPR. Because T-CPR, after all, is guided by professionals and its role is obvious.

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

This study finds that Chinese people's awareness of first aid is weak. People always feel that dangerous are far away from them. But once it happens, they often tend to be emotionally volatile. They dare not do CPR or don't do CPR. They just ask the emergency center to send an ambulance as soon as possible. They ask the dispatcher not to say anything else. This is obviously related to the weak first aid knowledge of the public in China. Non-professionals have not yet realized the importance of "time is life" for SCA patients. These require our society give more propaganda. We can popularize the basic knowledge and skills of CPR through various ways, arouse the public's awareness of first aid, create an atmosphere of first aid in the whole society, and form a good situation for ordinary people to sign up for CPR training voluntarily. Institutional organizations and enterprises require their employees to be trained initiatively. T-CPR should be introduced in CPR training. All of these will greatly facilitate the implementation of TCPR.

4.2 Develop appropriate T-CPR guidance process, standardize the guidance procedure, work in a multi-pronged manner and coexist with various guidance methods, which is an effective way to promote the implementation of T-CPR in China.

The traditional T-CPR guidance is mainly dispatcher guidance. However, this study finds that in China, dispatchers are lack of professional skills and dispatchers in some first-aid centers have been overloaded with dispatching work. So it is difficult to carry out T-CPR. Some dispatchers of first-aid centers do not have medical background and cannot perform T-CPR .In cities where T-CPR has been carried out, this study finds that their systems are imported from the United States. But Chinese national conditions are different from those of the United States, so it needs to be localized. This suggests that if T-CPR is to be carried out in China at this stage, for some first-aid centers in good conditions we can import advanced dispatching guidance system from abroad and then localize them, improve them to accord with Chinese national conditions, unify the training of first aid dispatchers, standardize the guiding procedures, and then carry out T-CPR guided by dispatchers. But in some first-aid centers where are lack of dispatchers or lack of professional skills of dispatchers , doctors or nurses should be involved in pre-hospital first aid and be trained for carrying out T-CPR. In addition, TCPR guidance software based on mobile phones can be developed. Studies have shown that [23], mobile phone application software guidance is better than telephone guidance in identifying the first compression time and some parts of compression action after SCA. By installing guidance software in smartphones, it can provide guidance for the witnesses who are willing to perform chest compression. It also can avoid the embarrassment that the publics are willing to implement CPR but not only lack official guidance but also lack legal support. Finally, the implementation rate of pre-hospital CPR for patients with cardiac arrest will be improved. This study also suggests that the coexistence of various guidance methods can promote the implementation of T-CPR. But no matter which guidance method, unified, simple, standardized flow chart is needed. It is very important to make the bystanders understand it and implement T-CPR in the first time.

4.3 Using internet technologies to build smart pre-hospital emergency system may promote the implementation of T-CPR.

At present, the world is in the information era of vigorous development of big data, cloud computing, artificial intelligence and other frontier technologies. Internet technology is being deeply integrated with all walks of life. The internet information has also become an important measure to raise the level of pre-hospital rescue.The early diagnosis of SCA and early positioning of SCA patients may be achieved by building a smart pre-hospital emergency system. This study

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

offers some new insights on it. For example, if the Wechat, which is widely used in China, can send the specific positioning of the patients to the dispatching center at the first time and provide the bystanders guidance of audio, video and text of CPR, so that more SCA patients will be treated.Smart pre-hospital emergency system is also possible to achieve intelligent calculation of the best route, so as to minimize emergency response time, and gradually achieve 'accurate dispatch' and 'precise treatment'.

4.4 Promoting the legislation of first aid exemption as soon as possible may promote the development of T-CPR.

As this study shows that China has not yet enacted relevant laws at the national level to protect dispatchers from disputes encountered in telephone guidance.The dispatchers will have some misgivings because their rights and interests are fundamentally not guaranteed when they conduct telephone guidance.Previous studies [24]by the research team also showed that a major concern of bystanders in implementing CPR is the lack of legal protection, especially when CPR is needed by the 'strangers' and 'acquaintances'. Therefore, it is urgent for the relevant departments to promote the legislation of first aid exemption as soon as possible, to clarify the scope and content of first aid exemption, so as to encourage more people to help patients with cardiac arrest and avoid tragedy.On January 1, 2015, Hangzhou, Zhejiang Province, China, began to implement *the Regulations on Pre-hospital Emergency Management in Hangzhou*, which put forward the public 'first aid exemption' and commendation regulations [25]. However, it is necessary to further promote all cities and regions in China.

4.5 Financial support from various channels, such as the state, local government or enterprises may promote the development of T-CPR.

This study shows that the amount of investment has a significant effect on the implementation of T-CPR.The software development of T-CPR, the allocation of instructors, the improvement of dispatching guidance system and the training of bystanders' CPR knowledge and skills all need sufficient financial support.Some economically developed cities, such as Beijing and Shanghai, can rely mainly on local financial input; some economically underdeveloped areas can be realized through state financial allocation; and other successful enterprises can give back social funds as a useful supplement.In short, life is more important than everything, and the value of life is paramount. We need to do more in first aid, which is also the most meaningful.

5. Conclusion

In order to save SCA patients more effectively, urge bystanders to implement CPR as soon as possible and ensure the quality of CPR implementation, it is urgent to promote the implementation of T-CPR in China.Through strengthening the training of bystanders' knowledge and skills of cardiopulmonary resuscitation, raising the awareness of first aid in the whole society may provide a solid foundation for the implementation of T-CPR. Through the development of T-CPR guidance process suited to Chinese national conditions, standardization of guidance procedures, multi-pronged approach and coexistence of various guidance methods may provide an effective way for the implementation of T-CPR. Using internet technologies to build smart pre-hospital emergency system may provide technical support for the implementation of T-CPR. It is necessary to promote the legislation of first aid exemption as soon as possible to clear up the concerns for the implementation of T-CPR. It needs financial support from various channels, such as the state, local government or enterprises, to provide adequate guarantee for the implementation of T-CPR.

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

Acknowledgments

We would like to thank all interviewees who participated in the qualitative research.

Funding source

This study was supported by MOE (Ministry of Education of the People's Republic of China) project of Humanities and Social Sciences (project No.15YJCZH247) and Wenzhou Municipal Science and Technology Bureau (project No.Y20150101).The findings and conclusions are those of the authors and do not necessarily reflect the view of Ministry of Education of China and Wenzhou Municipal Science and Technology Bureau.

Authors' contributions

All authors meet the requirements for authorship and manuscript submission. XHZ and LG designed the study. XHZ and XGX conducted the data collection, data analysis and led to complete all the manuscript sections. LG participated in coordination and data collection. YL and XGX participated in data analysis. All authors have read and approved the final manuscript.

References

[1]Benjamin E J, Blaha M J, Chiuve S E, et al. Heart disease and stroke statistics-2017 update: a report from the American Heart Association. Circulation. 2017, 135(10): e146-e603.

[2] Lixiang Wang, Qingyi Meng, Tao Yu. 2016 National consensus on cardiopulmonary resuscitation in China. Chinese Journal of Disaster Medicine. 2017, 5(01):1-23.

[3]Meaney PA, Bobrow BJ, Mancini ME, et al. Cardiopulmonary resuscitation quality: improving cardiac resuscitation outcomes both inside and outside the hospital: a consensus statement from the American Heart Association. Circulation. 2013, 128:417–35.

[4]Johnston T C, Clark M J, Dingle G A, et al. Factors influencing Queenslanders' willingness to perform bystander cardiopulmonary resuscitation. Resuscitation. 2003, 56(1): 67-75.

[5]Dobbie F, MacKintosh A M, Clegg G, et al. Attitudes towards bystander cardiopulmonary resuscitation: results from a cross-sectional general population survey. PloS one.2018, 13(3): e0193391.

[6]Kleinman M E, Brennan E E, Gold berger Z D, et al. Part 5: adult basic life support and cardiopulmonary resuscitation quality: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation.2015, 132(18_suppl_2): S414-S435.

[7]Vaillancourt C, Verma A, Trickett J, et al. Evaluating the Effectiveness of Dispatch-assisted Cardiopulmonary Resuscitation Instructions. Academic emergency medicine, 2007, 14(10): 877-883.

[8]Dami F, Fuchs V, Praz L, et al. Introducing systematic dispatcher-assisted cardiopulmonary resuscitation (telephone-CPR) in a non-Advanced Medical Priority Dispatch System (AMPDS): implementation process and costs. Resuscitation, 2010, 81(7): 848-852.

[9] Merchant R M, Abella B S, Abotsi E J, et al. Cell phone cardiopulmonary resuscitation: audio instructions when needed by lay rescuers: a randomized, controlled trial Annals of emergency medicine, 2010, 55(6): 538-543.

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.

[10]Bobrow BJ, Spaite DW, Vadeboncoeur TF, et al. Implementation of a regional telephone cardiopulmonary resuscitation program and outcomes after out-of-hospital cardiac arrest. JAMA Cardio 2016; 1(3):294–302.

[11] Shimamoto T, Iwami T, Kitamura T, et al. Dispatcher instruction of chest compression-only CPR increases actual provision of bystander CPR. Resuscitation 2015, 96:9–15.

[12]Fukushima H, Imanishi M, Iwami T, 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(4): 314-317.

[13]Bowen G A. Naturalistic inquiry and the saturation concept: a research note [J]. Qualitative research, 2008, 8(1): 137-152.

[14]Leavy, Patricia, ed. The Oxford handbook of qualitative research. Oxford library of psychology, 2014.581-605

[15]Malterud K, Siersma V D, Guassora A D. Sample size in qualitative interview studies: guided by information power [J]. Qualitative health research, 2016, 26(13): 1753-1760.

[16]Doody O , Noonan M . Preparing and conducting interviews to collect data[J]. Nurse researcher, 2013, 20(5):28-32.

[17]Flick U. An introduction to qualitative research[M]. Sage Publications Limited, 2018.

[18]Colaizzi P. Psychological research as the phenomenologist views it [M]//Existential phenomenological alternatives for psychology. New York: Oxford University Press, 1978:487.

[19]Morrow R, Rodriguez A, King N. Colaizzi's descriptive phenomenological method[J]. The psychologist, 2015, 28(8): 643-644.

[20]Juan Yi. Experience in the implementation of 100 million precise health projects for cardiopulmonary resuscitation in China.World Latest Medicine Information. 2018,18(97):285-287.

[21]Huijun Liang,Qi Zhong,Zhuangmiao Wei,et al. Cardiopulmonary resuscitation training in China. World Latest Medicine Information.2019,19(53):28-29

[22]Li Ma,Xiaorong Dong , Xu Fu,et al.Investigation on the status guo of cardiopulmonary resuscitation in Lanzhou residents and evaluation of intervention effects. Medical Information. 2019,32(1):132-134.

[23]Xiaowei Wang. Research on the guidance process and verification of pre-hospital cardiopulmonary resuscitation based on telephone and mobile App. The Second Military Medical University.2017,1-74

[24]Xuehua Zhu,Liping Jiang,Fuman Cai,et al.Investigation and analysis on the rescue willingness and obstacle factors among the public in Wenzhou. Chinese Medical Ethics.2013,26(04):532-534.

[25]Hangzhou People's Congress. Regulations of Hangzhou pre-hospital medical accompaniment emergency management. http://www.pkulaw.cn/fulltext_form.aspx?Gid=54eef7334c523180d8364428784a41c4bdfb&keyword=&Search_Mode=accurate&Search_IsTitle=0, 2014-10-27.

bioRxiv preprint doi: https://doi.org/10.1101/775874; this version posted October 28, 2019. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY 4.0 International license.