

Study on the construction of “first responder” scheduling mechanism for emergency treatment of cardiac arrest outside hospital in public places – Take South Sichuan as an example

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Abstract:

Objective: To understand the willingness and cognition of the public to participate in the emergency scheduling of defibrillation in public places in southern Sichuan Province, and to explore the influencing factors and practical factors of the application of the scheduling “first responder” mechanism in pre-hospital emergency of AED, so as to provide reference for the construction of the “first responder” scheduling mechanism for emergency treatment of cardiac arrest in public places. **Methods:** A self-designed questionnaire was used to investigate the permanent residents in Luzhou and Zigong in southern Sichuan through convenient sampling. **Results:** A total of 768 people were surveyed, of which 75.78% of the respondents expressed their willingness to be included in the scheduling database; 481 people (82.65%) can accept telephone scheduling; auxiliary rescue of patients with AED to the patient's location and direct to the patient's location was 55.5%; lack of first aid knowledge is the main reason for unwillingness to be dispatched (80.11%); 82.42% of the respondents said that the scheduling library list should introduce exit mechanism. **Conclusion:** Middle-aged and young people who are willing to be dispatched mainly have a certain level of education; lack of first aid knowledge may affect scheduling willingness and enthusiasm; the public is more willing to accept simple and effective scheduling methods such as telephone and SMS; the construction of the scheduling mechanism has a mass foundation. The public tends to focus on the government and the Red Cross, and the government-led construction conforms to the public expectations.

Keywords: Automatic external defibrillator; Out-of-hospital cardiac arrest; First responder; Scheduling mechanism; Public place

INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) is a worldwide public health problem. Automated External Defibrillator (AED) has the characteristics of portability and easy operation. Improving its effective utilization rate is of great significance for rescuing the life of patients outside the hospital. At present, the number of AEDs in China is about 0.2-0.3 per 100,000 population^[1], far below the international standard of 300 AEDs per 100,000 population. At the same time, there are about 544000 sudden cardiac death (CA)

events each year in China^[2], and the survival rate of rescue is less than 1%^[3]. In order to solve the contradiction between the number of configurations and the use demand, many places in China have successively introduced the AED configuration plan for public places. But only to increase the number of configuration, do not pay attention to supporting system construction, easily lead to waste of resources. 97.64% of China's AEDs have never been used, excluding places where there is no need to use events, China

does not have a formal “first responder” scheduling mechanism, lack of scheduling information support or an important factor^[4, 10]. Residents are the main source of the “first responder.” Residents’ recognition and support of the “first responder” system is the basis for the establishment and effective operation of the “first responder” scheduling system. To this end, the author attempts to explore the influencing factors and practical factors of the application of the “first responder” scheduling mechanism in pre-hospital care of AED by taking the permanent residents in southern Sichuan as the research objects, so as to provide reference for public places.

1. MATERIALS AND METHODS

1.1. Subjects of Survey

A total of 800 permanent residents in Luzhou City and Zigong City of Sichuan Province were selected by convenience sampling, and 768 valid questionnaires were collected. A self-designed questionnaire was used to collect data by unified trained investigators. Inclusion criteria: over 16 years old, conscious and action ability, voluntary participation.

1.2. Survey Instrument

General information questionnaire was designed by researchers. The contents of the questionnaire are the basic situation of the respondents, the cognitive situation of the respondents to the first respondent scheduling, the willingness to participate in the scheduling into the scheduling library, and the main factors that are not willing to participate in the scheduling.

1.3. Statistical Method

SPSS23.0 software was used for statistical analysis. The frequency indexes were mainly calculated for descriptive analysis and chi-

square test, in which the bilateral $\alpha=0.05$, $P<0.05$ was statistically significant.

2. RESULTS

2.1. Basic Situation

A total of 800 questionnaires were distributed, and 768 valid questionnaires were recovered, with an effective rate of 96.0%. Among them, there were 397 males (51.69%) and 371 females (48.31%); Age: 105 (13.67%) aged 16–24, 341 (44.4%) aged 25–44, 236 (30.73%) aged 45–59, and 86 (11.2%) aged ≥ 60 ; Degree: 194(25.26%) junior high school and below, 217(28.26%) senior high school, 162(21.09%) college, 195(25.39%) undergraduate and above. Occupation: 66 students (8.59%), 83 government/institution staff (10.81%), 136 individual operators (17.71%), 206 ordinary staff (26.82%), 100 freelancers (13.02%), 58 public places staff (7.55%), 63 retired (8.2%), 56 other occupations (7.29%).

2.2. The willingness and support of participating in the scheduling to rescue the life of patients with cardiac arrest

Among the respondents, 615 (80.08%) were willing to participate in the scheduling, and 153 (19.92%) were unwilling to participate in the scheduling; for whether they are willing to be included in the scheduling database, 582 (75.78%) choose to be included, and 186 (24.22%) do not want to be included.

Chi-square test shows that whether it is willing to be included in the scheduling database for different genders, different ages, different educational backgrounds, different occupations exist significant differences, with statistical significance, as shown in table 1.

Table 1 Analysis of influencing factors of whether they are willing to be included in the scheduling database of patients with cardiac arrest

	willing		unwilling		χ^2	P
	%	%	%	%		
gender						
female	269	72.51	102	27.49	4.193	<0.05
male	313	78.84	84	21.16		
age						
16-24 years old	91	86.67	14	13.33	148.437	<0.01
25-44 years old	292	85.63	49	14.37		
45-59 years old	178	75.42	58	24.58		
≥ 60 years old	21	24.42	65	75.58		
education level						
junior high school education or below	101	52.06	93	47.94	83.788	<0.01
senior high school education	174	80.18	43	19.82		
college degree	134	82.72	28	17.28		
bachelor degree and above	173	88.72	22	11.28		
occupation						
students	59	89.39	7	10.61	124.315	<0.01
government / institution officers	75	90.36	8	9.64		

ordinary office workers	159	77.18	47	22.82
freelancers	80	80.00	20	20.00
individual operators	110	80.88	26	19.12
Staff in public places	45	77.59	13	22.41
retirees	15	23.81	48	76.19
others	33	70.21	14	29.79

2.3 The acceptable ways and contents of scheduling

Among the respondents, 186 people are not willing to accept the scheduling. The main reasons for unwillingness to accept scheduling are that they do not have first-aid knowledge, fear of delaying schedule, and assume legal responsibility. Among the 582 people who are willing to accept scheduling, the dispatchee believes that telephone scheduling should be mainly adopted, accounting for 82.65%; 55.5 percent were willing not only to take AED to the patient's location but also to take direct assistance to the patient's location (both acceptable); for the after-use return of AED, the respondents believed that it should be returned by the configuration site manager, accounting for 43.81%, as shown in Table 2.

Table 2 Acceptable methods and contents of the respondents

investigation content	n	%
Will you accept scheduling		
yes	582	75.78
no	186	24.22
Reasons for unwillingness to accept scheduling		
worry to delay the schedule	103	55.38
fear of legal responsibility	90	48.39
lack of first aid knowledge	149	80.11
afraid to bear excessive moral public opinion requirements	85	45.70
others	30	16.13
The acceptable way to be scheduled		
telephone	481	82.65
short message	347	59.62
instant messaging	313	53.78
emergency special software	147	25.26
others	15	2.58
Willing to accept scheduled content		
only willing to take AED to the patient's location	139	23.88
only willing to accept the auxiliary rescue to the patient's location	120	20.62
both are acceptable	323	55.50
Who should return to the original location after using AED		
Configuration site manager	255	43.81
Scheduled	214	36.77
common people	95	16.32
others	18	3.09

2.4 Attitude towards the Construction of Scheduling Mechanism

The respondents think that the dispatching center should be set up separately 272 people (35.42%), should add new functions in the existing organization 496 people (64.58%); for the mode of operation of AED, 623 persons (81.12%) were considered free of charge; 41.93% were obtained by themselves through map software, public numbers, etc; 47.53% believed that the Red Cross should be responsible for the training and retraining of the dispatched; 65.76 percent believe that the funds for the training and retraining of scheduled personnel should be funded by the Government, as shown in table 3.

Table 3 Attitude towards suggestions on dispatching mechanism construction

investigation content	n	%
Existence form of dispatch center		
separately organized	272	35.42
adding new functions to existing organizations	496	64.58
AED operations		
compensated use	145	18.88
free use	623	81.12
Searching for AED mode on site		
get by yourself through map software, public number, etc.	322	41.93
find help from people around	243	31.64
the dispatched person sent AED to the patient position	192	25.00
others	11	1.43
Responsible parties for dispatcher training and retraining		
government and grass-roots organizations	353	45.96
red cross	365	47.53
work unit	40	5.21
self-responsibility	10	1.30
The responsible party for the training and retraining funds of the dispatcher		
government investment	505	65.76
red cross contributions	203	26.43
work unit	47	6.12
self-responsibility	13	1.69

2.5 Attitude towards Exit Mechanism Construction of Dispatching database

82.42% of people believe that the scheduling database list should introduce the exit mechanism, and the introduction of exit criteria is mainly for not participating in relevant training, accounting for 75.99%. The specific situation is shown in Table 4.

Table 4 Attitude towards the construction of dispatching database exit mechanism

investigation content	n	%
Whether the scheduling database list should introduce exit mechanism		
yes	633	82.42
no	135	17.58
Exit standard of scheduling database list		
long time does not participate in scheduling	346	54.66
no relevant training	481	75.99
unlawful acts	410	64.77
individual application for withdrawal	410	64.77
poor personal condition	368	58.14
others	18	2.84

3. DISCUSSION

3.1. People have a high willingness to dispatch, and the dispatch mobilization objects should be mainly middle-aged and young people with a certain cultural level.

The construction of the “first responder” scheduling mechanism can effectively improve the survival and discharge rate of patients^[5]. 80.08% of the respondents are willing to participate in the scheduling, and 75.78% are willing to be included in the database in order to realize the normalization of scheduling. It shows that

the public has the willingness to participate in the scheduling to save the lives of patients, but it has practical concerns to transform its willingness into practical action or maintain the willingness to regularize the scheduling. Nevertheless, a high proportion indicates that the public has a high enthusiasm for participating in scheduling to rescue patients with cardiac arrest outside the hospital, indicating that the construction of scheduling mechanism has a mass basis. In this study, people who are willing to accept scheduling are mainly 60 years old and below. People with senior high school and above, especially those with bachelor’s degree or above, are more willing to accept scheduling. People with low

degree tend to be reluctant to be included in the scheduling database. In terms of occupation, except for retirees, the willingness of all industries to accept scheduling is high, among which the willingness of government or institution personnel and students is the highest. Therefore, the author suggests that the object of dispatching mobilization should be given priority to young and middle-aged people with a certain cultural level, such as the priority to mobilize in-service government or institution personnel and students, through their mobilization to create a good atmosphere of social participation and the formation of systematic mobilization experience, and ultimately promote the participation of other groups, and the mobilization of students will also play a role in education and publicity, and play a very important role in forming a broad foundation of dispatching groups at the social level in the future.

3.2. The site personnel have the obligation of first aid and should participate in the specific scheduling process with the first responder.

55.5% of the respondents indicated that the scheduling content was acceptable for carrying AED to the patient's location and the auxiliary rescue to the patient's location, and 43.81% and 36.77% of the respondents believed that the post-use AED should be returned to the original location by the configuration site manager and the dispatched person, respectively, indicating that public participation in the first aid of patients with external fibrillation depended on the clear instructions of the scheduling content. Studies have shown that it is reasonable and effective to clarify different scheduling contents according to the relative position distance of the scheduler, AED, and OHCA patients. The proportion of people who only willing to accept direct access to the patient's location was 20.62%. At the same time, 43.81% of people said that after the use of AED, it should be returned to the original position by the configuration site manager. This indicates that a large proportion of people are not willing to carry AED equipment back and forth. Therefore, the author suggests that the daily maintenance of AED equipment, equipment tracking, and returning after use should be systematic and institutionalized. The place side, as the administrator of the equipment configuration, and as a potential "first responder", should bear the responsibility of first aid obligations and equipment use tracking return to the configuration point. The equipment manufacturer should provide technical support and equipment maintenance according to the content of the cooperation agreement, so as to avoid the equipment in the configuration state that cannot work. After the use of equipment scheduling, this link that is not easy to be paid attention to needs to be connected with equipment maintenance, so as to form a complete system. This requires the government and the Red Cross to take the lead, construct the scheduling system support, and promote the depth of cooperation between the place and the equipment manufacturer.

3.3. The government is responsible for the unified construction of dispatching system and should be responsible for the construction of specific dispatching system framework.

The results of interviews with government personnel and Red Cross staff in the process of data investigation show that government staff believe that the dispatching system is faced with low popularization rate of public emergency knowledge, it is difficult for dispatchers (the existing 120 emergency center system) to judge the specific condition of patients on the scene, involving moral and legal factors, and the masses are unwilling to use automatic external defibrillators and other obstacles. The survey results show that the public tends to construct the scheduling mechanism mainly by the government and the Red Cross, the training and retraining funds of the dispatched should be mainly funded by the government, and the training should be carried out by the Red Cross and the government and grassroots organizations, and the function of the scheduling center should be given in the existing organization.

The government co-ordinates the allocation of AED in public places, encourages the public to receive AED training, and implements the Public Access Defibrillation (PAD)^[6]. At the same time, it also needs to be led by the government to build the supporting "first responder" scheduling mechanism. Government investment is insufficient, there is no unified planning and construction scheduling center, blindly increase the number of AED configuration is not desirable. Therefore, the government should ensure the effective development of Red Cross training and retraining according to the amount of AED allocation, AED planning demand, different regions within the jurisdiction, population characteristics, PAD planning, and construction. The government should encourage the AED configuration innovation model, encourage the introduction of social capital, such as in order to introduce social capital while allowing them to put public service advertising or neutral advertising near the AED configuration equipment, to enhance the sponsor's brand power but also play a role in diversification of funding sources; government departments should clarify the configuration and maintenance of AED equipment through experience reference, data collection, and scientific analysis, and verify and implement the supporting systems such as late use and scheduling of AED equipment. The government should issue guidance documents to play the mandatory role of the government, and make requirements for the allocation of AED equipment in public places for the management of fire fighting and security equipment.

3.4. 120 Command Center is responsible for emergency command and dispatch functions, with the practical feasibility of adding "first responder" dispatch.

The current 120 command center is an organizational system that integrates call-and-rescue acceptance and command and dispatch, which belongs to off-hospital medical assistance. On this basis, increasing the "first responder" dispatch function is the development and progress of off-hospital emergency medical system. It is an additional function according to social medical needs, which is feasible and realizable. The 120 hotline has the basis of adding cardiopulmonary resuscitation consultation or "first responder" dispatching hotline function. The survey shows that 64.58% of the respondents support the addition of new functions in the existing institutions, indicating that the addition of "first

responder” dispatching center function in the 120 command center is in line with public expectations and has a mass base. It is necessary to add functions in the current organization, so it is necessary to adjust and follow up relevant laws and regulations, clearly protect the legitimate rights and interests of the “first responder” in participating in the process of emergency defibrillation scheduling outside the hospital, clarify the maintenance and repair accusation of AED in the process of scheduling and use and afterwards, and clearly define the work content and function scope of 120 command center.

3.5. Cardiopulmonary resuscitation and AED operation on the same track training, improve the training system, improve the quality of training.

80.11% of the respondents believed that their lack of first aid knowledge was the main reason for their reluctance to accept scheduling, indicating that lack of first aid knowledge might affect public willingness and enthusiasm for scheduling. The study found that lack of first aid knowledge can also affect public willingness and confidence to rescue^[7-8]. Moreover, the public believes that the scheduling library list should be introduced into the exit mechanism according to certain standards and that the absence of relevant training in the exit mechanism should be the main reason for the exit to ensure the effectiveness of the scheduling mechanism. The operation of AED is simple, but if the operation is improper, it will also affect its automatic defibrillation decision, which is not conducive to timely rescue the life of patients. In order to give full play to the role of the first responder, only training AED operation knowledge is not enough, we must popularize cardiopulmonary resuscitation (CPR). At present, AED operation training and CPR training are independent training. Trainers have no active choice in the actual rescue of OHCA patients, and it is difficult to adopt targeted measures according to the actual situation. The lack of first aid knowledge will also affect the enthusiasm of participating in first aid. The training process also lacks the corresponding practical operation link, and it is difficult to implement the “first responder” scheduling mechanism under the current training mode. It is found that the introduction of practical training in AED operation training will effectively improve the correct completion rate of students^[9]. Therefore, it is suggested to improve the training system, be responsible for the diversification of training subjects, give full play to grassroots organizations, medical institutions, and other forces, and expand the training subjects to community and township hospitals. Training hours should be led by the Red Cross to establish a unified management system, and training hours between different subjects are mutually recognized and can be superimposed. The training process should be innovated and the training link should be introduced. In the training process, the simulation scenario should be set and the embedded training strategy combining CPR and AED should be adopted.

3.6. Introducing video surveillance system to create “intelligent first responder” linkage mechanism.

The research shows that the scheduling of the first responders in foreign countries mainly depends on the emergency center.

Through the global positioning system, mobile phones, Internet, and other scheduling and dispatching, some results have been achieved^[10]. It has the advantages of rapid response and full utilization of resources, but at the same time, the author believes that there are some drawbacks in foreign scheduling mechanisms: (1) artificially triggering the response of the scheduling center, that is, when someone calls the scheduling center, the scheduling center will respond. However, for patients with OHCA, the time spent before triggering is particularly valuable. (2) It is not possible to respond all-weather, and it is difficult to trigger the dispatch center response at night in public places with fewer people. Therefore, it is necessary to establish the “first responder” scheduling system based on different emerging technologies according to the actual situation of society. The coverage of monitoring in public places in China is high. The introduction of video surveillance may be a breakthrough in the construction of formal ' first responder ' scheduling system in China. Its advantages lie in: (1) Giving video surveillance new social functions and optimizing the cost-effectiveness of monitoring. (2) The coverage rate of monitoring in public places is high, and it is highly targeted for OHCA patients in public places. (3) Emergency response can be achieved in places with low night/population flow, which can effectively connect the pre-hospital emergency force of the hospital and make up for the lack of first responders.

The integration of behavioral science and computer intelligence technology also provides technical possibilities for the creation of “intelligent first responder” system. Video surveillance system and other systems can have data interaction. For example, when the video private network and public security information network system are connected with the shared platform and the Internet respectively, GB/ T28181-2016 standard is used to implement^[11]. Video surveillance technology embeds intelligent algorithm into digital processing technology chip, and forms the core algorithm by analyzing and refining various behavior patterns of monitoring targets. According to the dynamic changes of monitoring targets, combined with location, time, and other information, we can determine whether there are patients with external cardiac arrest^[12]. Therefore, the government and the Red Cross should actively cooperate with relevant scientific research institutions to invest in the development and application of special funds; scientific research institutions not only need to focus on basic research but also need to widely carry out applied research, deepen industry-university-research cooperation and improve social benefits; pay attention to publicity and training, improve the social understanding of the construction of “first responder” scheduling system. The introduction of new technologies to create “intelligent first responder” mechanism has great advantages and feasibility. At the same time, it retains artificial trigger scheduling and increases intelligent trigger scheduling mechanism. The process is as follows: monitoring facilities in public places intelligently capture suspicious images, and dispatch information is sent after manual confirmation by the dispatch center, which has three copies. First: sent to the nearest pre-hospital emergency center for OHCA patients. Second: send a message (including: patient or AED location information, recommended CPR) to the first responder within the effective distance of OHCA patients to carry out CPR

assistance. Third, the first responder sent to the nearest effective distance of AED by SMS (including AED and patient location information, voluntary selection) carried AED to rescue; the dispatching center establishes a fast linkage channel with the public security part, and the dispatching center plans the ambulance route remotely to coordinate the traffic police to ensure smooth traffic. To establish a fast response mechanism of "video surveillance-scheduling center-first responder-prehospital emergency"

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