

Prevention and Control of Cardiac Arrest in Healthy China

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Summary

Cardiac arrest (CA) usually occurs out of hospitals, comprising approximately 50% of all cardiovascular deaths, which may delay achievement for Healthy China 2030 goals for life expectancy and premature death from major chronic diseases. In this review of Chinese law and health policy, challenges and opportunities are explored for CA prevention and control. A considerable gap would remain even if the CA target in Healthy China 2030 are to be achieved on schedule. Therefore, CA should be included in the national disease prevention and control system and national projects, such as the Healthy Cities Initiative and the Primary Public Health Services to accelerate population-wide Cardiopulmonary Resuscitation training and Automatic External Defibrillation availability. Principles of CA prevention and control should be integrated into all relevant policies.

BACKGROUND

Cardiac arrest (CA) is a serious clinical condition and the initial symptom in one-fourth of cases of cardiac disease, contributing to approximately 50% of all cardiovascular deaths worldwide (1–2). CA usually occurs out of hospitals and is often unrecognized in patients with a low risk of cardiovascular disease or who have occult heart disease (2). The rate of emergency medical services (EMS) attending out-of-hospital cardiac arrest (OHCA) varies substantially, from 20.9 per 100,000 people in Singapore to 186.0 per 100,000 people in Rochester, United States. The estimated annual mortality from CA is as high as 4–5 million deaths worldwide, with 544,000 deaths in China (2–3). An autopsy study showed that only 20% of sudden cardiac deaths — a common outcome of CA — were associated with cardiovascular risk factors. Therefore, much about the etiology of CA is unknown, and CA remains unpredictable (4).

One intervention that may reduce mortality from OHCA in non-hospital scenarios is “bystander”

cardiopulmonary resuscitation (CPR). However, bystander CPR is underutilized in China, with implementation rates of only 11.4% in Beijing and 4.2% in Shanghai, which are much lower than 46.1% in the United States and 32.2% in Japan (5). As a result, the success rate of OHCA rescue is as low as less than 1% in China, compared with approximately 10% in other developed countries (6).

High incidence of and mortality from CA may delay achievement of the Healthy China 2030 goals on life expectancy and premature mortality from major chronic diseases. Here, the aim of this article is to discuss challenges and opportunities for CA prevention and control by reviewing the laws and health policies related to CA in China.

KEY CONTENTS & TARGETS

The *Healthy China Initiative (2019–2030)*, including two government-driven campaigns related to CA — health literacy and cardiovascular/cerebrovascular disease prevention and treatment — will guide our work over the next 10 years (Table 1). CA-related first aid is the first topic of the *Campaign of Cardiovascular and Cerebrovascular Disease Prevention and Treatment*, but there is only one quantitative assessment indicator monitored by the government, which is the rate of emergency rescue training among residents, with training of teachers being the primary strategy chosen to achieve improvement of this indicator. In 2020, the Red Cross Society and the Ministry of Education of China issued a joint notice to strengthen CPR training and train teachers specialized in emergency education. The plans involve installing automatic external defibrillations (AED) in crowded places, including schools, workplaces and institutions, airports, transport stations, shopping malls, and cinemas. Organizations involved in implementation of this effort include the National Health Commission, the Ministry of Education, the Ministry of Finance, and the Red Cross Society of China.

TABLE 1. Campaigns related to cardiac arrest in the *Healthy China Initiative (2019–2030)*.

Campaign	Government-monitored indicators	Main practices
Health literacy campaign	Mastering basic knowledge and skills on of first aid including CPR	Encouraging professional institutions and media to educate the public; encouraging residents to master essential skills, such as making an emergency call and CPR; encouraging families to have the first aid kits
Cardiovascular and cerebrovascular disease prevention and treatment campaign	Percent of residents with certification in emergency rescue training: $\geq 1\%$ in 2022 and $\geq 3\%$ in 2030	Supporting professional institutions to carry out mass emergency rescue training; training teachers in primary and secondary schools, 1 teacher trained for each 50 students in the first aid
	Outside the monitored indicator system	Providing the first aid drugs and AEDs in crowded places; providing an ambulance for every 50 thousand people; achieving 100% of 10-second answering rate for pre-hospital medical emergency institutions; increasing the 5-minute departure rate of ambulances

Abbreviations: CPR=cardiopulmonary resuscitation; AED=automatic external defibrillation.

STRATEGIES

Timely and effective bystander CPR may be the best hope for survival once CA occurs. Initiating CPR within 1 minute of CA and use of AEDs within 3–5 minutes can increase CA survival rate to 50%–70% (7). Currently, there are four national laws closely related to increase in CA survival (Table 2). Among these, the *Civil Code* implemented in 2021 is particularly important for legally protecting bystanders who are not medical staff when witnessing a CA and providing onsite first aid. The *Primary Healthcare, Medicine, and Health Promotion Law* implemented in 2020 guarantees comprehensive measures to improve onsite first aid in terms of training potential bystanders, public participation, availability of equipment, and mechanisms for legal protection. The ongoing *Law for Medical Practitioners* is anticipated to play a key role in encouraging and protecting medical practitioners to implement a rescue for OHCA by exempting medical practices from restrictions on place, category, and specialty. Lastly, the *Law of the Red Cross Society* revised in 2017 authorizes the Red Cross Society of China — a non-governmental organization (NGO) — to establish an emergency rescue system in an attempt to improve likelihood of successful rescue from CA.

To supplement national laws, some local governments have enacted detailed regulations to support CA rescue. For example, considering people who are likely to become witnesses of a CA, public transportation drivers and attendants, teachers, tourist guides, firemen, policemen, security staff, and pension service personnel are designated as specific recipients of CPR training in Hunan Province, Shanghai Municipality, Hainan Province, and Nanjing City.

The *Regulations of Hunan Province on Spot Rescue* stipulates that CPR training should be included in all types of school curriculum. As the availability of AED devices is essential for onsite first aid for CA, the above regulations require or encourage provision of AEDs in crowded or high-CA-risk places such as transportation hubs, tourist attractions, stadiums, conference and exhibition centers, nursing homes, and schools.

PERSPECTIVE

Considering that the average response time of pre-hospital emergency medical services is usually more than 15 minutes in urban areas of China, earlier initiation of high quality bystander CPR and AED use are crucial for saving the lives of OHCA victims (6,8). However, the current CPR training rate among Chinese residents is less than 1%, much lower than the 33% reported in the United States and 40% in France (5). Moreover, the number of AEDs per 100,000 Chinese residents is dramatically lower than that in many industrialized countries (17.5, 13, and 5 in the developed Chinese cities of Shenzhen, Haikou, and Shanghai, respectively, *vs.* 700, 276, and as high as 3,399 in the United States, Japan, and in parts of France, respectively) (7). These gaps between China and other industrialized countries must be overcome by developing laws and policies. In particular, the key elements of CPR training and provision of AED equipment specified in some local laws should be raised to the level of national laws.

In terms of CPR training, it remains to be determined who should be trained, who should conduct the training, and who should support the training. Health practitioners and people likely to be first to witness CA events are prime candidates for

TABLE 2. Current national laws closely related to cardiac arrest in China.

Name	Basic description	Function in cardiac arrest
<i>Law for Medical Practitioners</i>	A draft of this law, issued on January 27, 2021, is based on a revision of a similar 1999 law	We suggest that medical practitioners should be encouraged and protected to implement OHCA by exemption from restrictions on their medical practice such as place, category, and specialty by this law, although this draft includes rescue for patients in case of emergency.
<i>Civil Code</i>	China's first law named after the code occupies a fundamental position in the legal system; implemented on January 1, 2021	Articles 183 and 184 provide a basic guarantee of civil rights for any bystander who conducts out-of-hospital CPR; Article 1,005 requires organizations or individuals with legal obligations to fulfill their own rescue duties.
<i>Primary Health Care, Medicine and Health Promotion Law</i>	China's first basic and comprehensive law in the field of health; implemented on June 1, 2020	Article 27 establishes and improves a pre-hospital first aid system, defining what the jobs of the government as following: 1) carrying out first aid training and public education; 2) encouraging onsite first aid; 3) providing first aid facilities in public places; 4) forbidding refusal and delay from first aid centers due to fees.
<i>Law of the Red Cross Society</i>	2017 revised version with functions of the Red Cross Society in non-war or non-armed conflict scenes added.	Article 11 defines the functions of the Red Cross Society, including establishing an emergency rescue system, carrying out emergency rescue training, popularizing emergency rescue and health knowledge, and organizing volunteers to participate in onsite rescue.

Abbreviations: OHCA=out-of-hospital cardiac arrest; CPR=cardiopulmonary resuscitation.

CPR training. CA training should be considered for inclusion in the national disease prevention and control system, where professional public health institutions such as CDCs can more effectively organize and mobilize the general population. This would not only be responsive to requirements of recent legislation, but also helps offset limitations of the Red Cross Society as an NGO. Establishing permanent professional positions for CPR trainers will help address deficiencies in the availability of training for the public. In terms of AEDs, it is essential to increase the number of AEDs and optimize the placement of AED sites. For example, the local laws noted above suggest many locations for AED sites; however, in communities where the majority of OHCA occur at home [e.g., 84.7% and 92% before and after the COVID-19 pandemic in Lombardy, Italy, respectively (9)], this may be insufficient, as community-based AED placement does not feature in any of China's laws or policies.

Current CA-related policy measures in the *Healthy China Initiative* lag behind the law, despite priority being placed on health and prevention in rapidly developing legislation - likely due to the locus of CA prevention and control being largely beyond the reach of the healthcare system. Even if the *2030 Healthy China* targets are achieved on schedule, a significant gap with other countries will remain. Therefore, we suggest that CPR training and placement of AEDs be featured in the index systems of the National Healthy Cities, the National Demonstration Areas for the Comprehensive Prevention and Control of Chronic

Diseases, and the National Primary Public Health Services projects. These projects either effectively mobilize government resources or cover a large number of people, which will help to dramatically increase coverage of CPR training and AEDs among the population. Furthermore, in adherence to the principle of including health promotion in all policies, standards for the placement of AEDs should be considered and integrated into all types of building codes, including specifications for construction of civilized cities and beautiful villages to improve AED coverage for CAs.

Since the beginning of the COVID-19 pandemic, CA cases have increased and the rate of restoration of spontaneous circulation (ROSC) from OHCA has dramatically decreased. This may be because the coronavirus attacks the cardiopulmonary system and because of the strain the pandemic has placed on medical resources. For example, 19.8% of patients with severe COVID-19 pneumonia experienced an in-hospital CA in a single-centered, retrospective, observational study conducted in Wuhan City, Hubei Province; mortality due to CA increased by 58% in the Lombardy region of Italy; and the ROSC rate dropped to 0.4% in February 2020 from about 4.5% before the COVID-19 outbreak in Hangzhou City (9–10). It is therefore urgent to add CA to the monitoring and early warning mechanisms of public health emergencies, required by the Central Committee of the Communist Party of China, in accordance with the principle of “people first and life first.”

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REFERENCES

- Krokhaleva Y, Vaseghi M. Update on prevention and treatment of sudden cardiac arrest. *Trends Cardiovasc Med* 2019;29(7):394 – 400. <http://dx.doi.org/10.1016/j.tcm.2018.11.002>.
- Al-Khatib SM, Stevenson WG, Ackerman MJ, Bryant WJ, Callans DJ, Curtis AB, et al. 2017 AHA/ACC/HRS guideline for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death: a report of the American college of cardiology/American heart association task force on clinical practice guidelines and the heart rhythm society. *J Am Coll Cardiol* 2018;72(14):e91 – e220. <http://dx.doi.org/10.1016/j.jacc.2017.10.054>.
- Hua W, Zhang LF, Wu YF, Liu XQ, Guo DS, Zhou HL, et al. Incidence of sudden cardiac death in China: analysis of 4 regional populations. *J Am Coll Cardiol* 2009;54(12):1110 – 8. <http://dx.doi.org/10.1016/j.jacc.2009.06.016>.
- Ifteni P, Barabas B, Gavris C, Moga M, Burtea V, Dracea L, et al. Sudden cardiac death: autopsy findings in 7200 cases between 2001 and 2015. *Am J Forensic Med Pathol* 2017;38(1):49 – 53. <http://dx.doi.org/10.1097/PAF.0000000000000274>.
- Xu F, Zhang Y, Chen YG. Cardiopulmonary resuscitation training in China: current situation and future development. *JAMA Cardiol* 2017;2(5):469 – 70. <http://dx.doi.org/10.1001/jamacardio.2017.0035>.
- Shao F, Li CS, Liang LR, Li D, Ma SK. Outcome of out-of-hospital cardiac arrests in Beijing, China. *Resuscitation* 2014;85(11):1411 – 7. <http://dx.doi.org/10.1016/j.resuscitation.2014.08.008>.
- Lyu CZ, Zhang H, Chen S, Liu XR, Tian GG, Yan SJ. Expert consensus on layout and delivery of AED in China. *Clin J Crit Care Sep*, 2020;40(9): 813-9. <https://doi.org/10.3969/j.issn.1002-1949.2020.09.003>. (In Chinese).
- Qi TF, Jing J. Response time of pre-hospital first aid in urban regions in China, 1996-2015: a meta-analysis. *Chin J Public Health* 2017;33(10):1466 – 8. <http://dx.doi.org/10.11847/zgggws2017-33-10-12>. (In Chinese).
- Shao F, Xu S, Ma XD, Xu ZM, Lyu JY, Ng M, et al. In-hospital cardiac arrest outcomes among patients with COVID-19 pneumonia in Wuhan, China. *Resuscitation* 2020;151:18 – 23. <http://dx.doi.org/10.1016/j.resuscitation.2020.04.005>.
- Yang FL, Yuan YJ, Song YL, Lu X. The Effect on the out-of-hospital system of patients with out-of-hospital cardiac arrest during the COVID-19 outbreak in one city in China. *Ann Emerg Med* 2020;76(5):687 – 9. <http://dx.doi.org/10.1016/j.annemergmed.2020.05.032>.