

Automated External Defibrillator Facility Layout Status and Recommendations in the Main Urban Area of Huzhou

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ABSTRACT. *Based on public data and GIS technology, this paper analyzed the layout of AED facilities in the main urban area of Huzhou city through visit analysis. The study found that currently urban AED network construction is in the initial stage, and the effective coverage rate of statistically available facilities in urban built-up areas is just over 4.57%, with 2.3 sets per 100,000 people. AED facilities are most often located in university and public sports venues, and few are in major commercial buildings. According to the literature, more than 70% of out-of-hospital cardiac arrest incidents occurred at home, and there was not a residential community equipped with AED facilities in the Huzhou urban area. It is suggested that the number of AED facilities should be increased year by year in the form of "government leading, financial support and private participation", and the overall layout should be adjusted to increase investment in residential communities.*

KEYWORDS: *Automated External Defibrillator, Layout Status*

1. What is AED?

AED, namely Automated External Defibrillators, are equipment that are portable, easy to operate, easy to understand after training, and designed specifically for field first aid. According to the National Cardiovascular Center, the number of sudden cardiac deaths in China is as high as 550,000 each year, ranking first in the world. In the case of sudden cardiac arrest, only in the "golden four minutes" of the best rescue time, the use of automatic external defibrillator (AED) for patient defibrillation and cardiopulmonary resuscitation is the most effective way to stop sudden death.

2. AED facility distribution in urban area of Huzhou

At present, the number of AED equipment configured for every 100,000 people in developed countries' metropolitan areas basically exceeds 100 sets. China's major coastal cities have also caught up in recent years, accelerating the investment of

AED equipment. What about the AED configuration in the third and fourth cities with a large number of people living in most of China's cities? As a prefecture-level city under the jurisdiction of Zhejiang Province, Huzhou is one of the 27 cities in the central area of China's economically developed Yangtze River Delta. It consists of 2 districts and 3 counties, covers an area of 5,820.13 square kilometers, and has a permanent resident population of 3.06 million in 2019. Wuxing District is the main urban area of Huzhou, with a total area of 863 square kilometers, among which the urban built-up area is about 110.1 square kilometers; In 2019, the registered population was 629,900, and there are about 910,000 permanent residents, including temporary residents. It is the economic, cultural and educational center of the municipal government and Huzhou. In this paper, the author has been living in Wuxing area, and is familiar with local conditions, combined with the Huzhou suburb AED configuration is almost blank. Thus, Huzhou urban District, a typical third-level city in southeast China, is taken as a sample. The research on the layout of AED facilities can "get a glimpse of the whole picture", and provide reference and advice for promoting the rational planning and layout of AED equipment network in the third and fourth-level cities in China's economically developed regions and benefiting residents.

According to the author's interviews with the Red Cross Society, community and other relevant units in Huzhou city, and combined with the data of *Huzhou Yearbook*. There are 21 AED facilities available in the urban area of Huzhou city, and the distribution is shown in the table below:

Table 1 Table of distribution points of AED facilities in Huzhou main Urban area

Type	Quantity (unit)	Remarks
Government department	1	Citizen Service Center
Public sports venues	8	Huzhou National Fitness Center, Huzhou Gymnasium, Olympic Sports Center
High speed railway station	1	Huzhou High Speed Railway Station
University	5	Huzhou University, etc
Pharmacy	1	Detaiheng pharmacy in clothes street
Large enterprise	3	State Grid Huzhou Power Supply Company
Hotel	1	In Huzhou, the number of guest rooms of more than 100 hotels is 14
Grand Theater	1	Huzhou Grand Theater
Cinemas and theatres	0	The total number of cinemas and theatres in the city is 9
Private gym	0	The total number of gyms in the urban area is 19
Large shopping mall	0	The total number of large shopping malls in the city is 11
Primary and secondary school	0	The total number of urban primary and secondary schools is 45
Residential community	0	The total number of urban residential communities is 77
Public park	0	The total number of major public parks in the city is 12

Theory and practice have proved that in the case of sudden cardiac arrest, only in the "golden four minutes" of the best rescue time, the use of AED equipment for first aid is the most effective rescue means to prevent sudden death.

If starting with someone having a heart accident, the helper notices the patient and recognizes the need to use a nearby AED facility and retrieves it at full speed with all power. If the helper knows the location of the facility, knows the road and is physically active, the helper can only access the AED facility within about 400 meters of the facility. If a helper on the spot sends out a distress call and a nearby AED facility is manned and immediately received, the facility's service radius can be doubled to about 800 meters for a single trip of equipment. Considering that ideal conditions rarely exist in the real world, that road traffic is complex, far from "going straight" on a map, and there should be time to maneuver in judging and operating equipment. For this reason, the American Heart Association recommends a "golden response time" of three minutes for a trained first respond people to bring an AED to the scene after a cardiac arrest.

Therefore, in order to effectively play the role of AED equipment, its service radiation radius should not exceed 300 meters at the time of self-pickup and 600 meters at the time of single shipment. The author uses the GIS spatial analysis technology to get an analysis that under the existing conditions in Huzhou city, the distribution of all AED facilities according to the radiation radius of 300 meters can cover is about 5.029 square kilometers. According to the radiation radius of 600 meters, it covers 19.026 square kilometers (about two adjacent AED facilities services overlap part of the area of the CAD software is used for calculating correction). Therefore, AED facilities covered 17.28% of the urban built-up area of Huzhou under the loose condition (600m radius), but under the strict condition (300m radius), the effective coverage rate of urban built-up area is about 4.57%.



Figure 1 Huzhou spatial distribution map of AED facilities in main urban area



Figure 2. Huzhou schematic diagram of the effective service area of AED facilities in the main urban area with a radius of 300 meters

3. Huzhou analysis on the layout of AED facilities in the main urban area

3.1 Research ideas and methods

The number of AED facilities in Huzhou's main urban area is still small. Are these AEDs properly positioned? How can the emergency services at AED facilities reach more people with limited public resources? The installation of AEDs in public places with high population concentrations and mobility is a common option for such equipment.

If the government is flush with its budget, full-space configurations can be arranged with a service radius of 300 or 600 meters, as many Japanese cities have done. Huzhou's AED network is still in its initial stage, and needs to be rationalized according to the density of the floating population and the location of cardiac arrest events. At present, mobile phone use has been widely popularized. Combined with GIS and big data of mobile phone use, real-time population concentration and flow map of survey area can be accurately drawn, helping relevant departments to locate AED facilities in places with high population density all day long. However, as the mobile phone big data is confidential information, the author had to find a new way to plot and analyze the public places with large floating population in the urban area of Huzhou based on the public information. On the other hand, literature shows that more than 70% of cardiac arrest events occur at home. For this reason, the author visited major residential communities in Wuxing District to understand the configuration of AED facilities in residential areas. According to the available

public information, the author marked the main public places on the map of the main urban area of Huzhou, namely stations, universities, stadiums, libraries, large commercial centers, cinemas and theaters, etc., and marked different types of public places with different icons. Then combined with the map of 600m radius of AED facilities, the situation of the existing AED equipment service area covering the main public places is analyzed (see Figure 3).



Figure 3 Huzhou schematic diagram of main public places with existing AED facilities and service radiation (600m radius) in the main urban area

3.2 Research conclusion

1) At present, the construction of AED emergency network in Huzhou is still in its initial stage, with 2.3 units per 100,000 population in the main urban area. There is great room for improvement in the number and coverage of equipment. The construction of the existing AED network is the own planning and investment of several departments, schools and state-owned enterprises, which requires the overall arrangement at the municipal level to achieve a more reasonable layout on the basis of limited funds.

2) The areas with the highest concentration of AED facilities were municipal stadiums and major commercial districts, indicating that the government gave priority to densely populated public places in the early days of the AED network. All the university in Huzhou have AED, indicating that the concept and action of university emergency rescue have been in the forefront of the society.

3) Primary and secondary schools and residential communities do not have AED facilities.

4. Suggestion

1) It is suggested that Huzhou increase its special investment in AED facilities year by year, and initially build an urban emergency service network for AED facilities within three years, covering 25.0% of the urban built-up area under a radiation radius of 300 meters. Under the leadership of the government, enterprises and non-governmental resources should be brought into actively participate in the construction and maintenance of AED network. Large and medium-sized enterprises are encouraged to purchase AED equipment on their own initiative, and the government will provide tax and special subsidies support, especially in densely populated commercial places, such as cinemas, gyms, hotels and guesthouses. At the same time, each road patrol car in the city should be equipped with AED to make up for the shortage of emergency radiation range of fixed AED facilities.

2) For AED facilities to play a full role in first aid, they must "know where to find, be able to use and dare to operate", so it is necessary to popularize first aid knowledge among the public. At the present stage, it is suggested to combine the driving license test with the annual training system for safety officers in enterprises and public institutions, and set up the elective course of First Aid Knowledge and Operation in universities, so as to steadily cultivate a group of backbone who know theory and can operate every year. At the same time, AED emergency module is integrated into the citizen card/social security card/public transportation APP commonly used by residents. Its functions include on-site alarm (the system not only calls for help from the emergency center, but also automatically notifies the trained first respond people nearby), the location and route of the latest AED equipment, and other information.

3) Since 70 percent of cardiac arrests occur at home, it is recommended that residential communities deploy AED facilities as soon as possible, using "a bit from the government, a bit funds from the community, a bit from the property". The equipment can be installed in a 24-hour manned security/property office and widely publicized to all residents. Property management personnel should receive training in first aid skills as a prerequisite for taking up the post. As the security guards and property management personnel are familiar with the environment of the community, they can arrive the residents' homes and carry out first aid after receiving the alarm signal, thus winning the precious "golden four minutes".

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