

2025 Korean Guidelines for Cardiopulmonary Resuscitation: Part 2. Current status of cardiac arrest and the chain of survival

Sung Oh Hwang¹ , Kyoung-Chul Cha¹ , Woo Jin Jung¹ ,
Young-Il Roh¹ , Gyo Jin Ahn¹ , Do Kyun Kim² , Tae-Youn Kim³ ,
Youdong Sohn⁴ , Gyuhong Shim⁵ , Young Hwa Jung⁶ , Yunhee Oh⁷ ,
Chun Song Youn⁸ , Mi Jin Lee⁹ , Jisook Lee¹⁰ , Chang Hee Lee¹¹ ,
Youngbin Jang¹² , Yong Soo Jang⁴ , Gyu Chong Cho⁴ , Ju Sun Heo⁶ ,
Sung Phil Chung¹² 

¹Department of Emergency Medicine, Yonsei University Wonju College of Medicine, Wonju, Korea

²Department of Emergency Medicine, Seoul National University College of Medicine, Seoul, Korea

³Department of Emergency Medicine, Inha University Hospital, Inha University College of Medicine, Incheon, Korea

⁴Department of Emergency Medicine, Hallym University College of Medicine, Chuncheon, Korea

⁵Department of Pediatrics, Inje University Sanggye Paik Hospital, Seoul, Korea

⁶Department of Pediatrics, Seoul National University College of Medicine, Seoul, Korea

⁷Design and Contents Team, Asan Medical Center, Seoul, Korea

⁸Department of Emergency Medicine, College of Medicine, The Catholic University of Korea, Seoul, Korea

⁹Department of Emergency Medicine, St. Vincent's Hospital, College of Medicine, The Catholic University of Korea, Suwon, Korea

¹⁰Department of Emergency Medicine, Ajou University School of Medicine, Suwon, Korea

¹¹Department of Paramedicine, Namseoul University, Cheonan, Korea

¹²Department of Emergency Medicine, Yonsei University College of Medicine, Seoul, Korea

In Korea, more than 30,000 out-of-hospital cardiac arrests (OHCAs) occur each year, and the survival rate remains below 10%. Because OHCA is difficult to predict and typically occurs outside medical facilities, effective management requires not only healthcare professionals but also laypersons, including bystanders and first responders. Survival depends on an uninterrupted and efficient sequence of time-critical actions: early recognition of cardiac arrest and activation of emergency services; prompt bystander cardiopulmonary resuscitation (CPR); use of an automated external defibrillator (AED) for shockable rhythms; on-scene and in-hospital advanced life support with comprehensive post-cardiac arrest care; and systematic assessment of neurologic and functional outcomes followed by rehabilitation and recovery. The chain of survival describes these essential steps required to maximize survival after cardiac arrest and comprises five links: (1) early recognition and call for help; (2) immediate bystander CPR; (3) early defibrillation with an AED; (4) advanced life support and post-cardiac arrest care; and (5) rehabilitation and recovery for survivors. The cardiac arrest survival environment represents a societal infrastructure that sustains and optimizes both medical and non-medical factors across prevention, treatment, and rehabilitation to reduce mortality. Establishing such an environment requires each community to develop integrated medical systems for prevention, treatment, rehabilitation, and recovery, alongside nonmedical strategies, including public awareness initiatives, widespread CPR education and bystander participation, AED dissemination, and coordinated community responsiveness of the emergency medical system.

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Correspondence to:

Sung Phil Chung

(emstar@yuhs.ac)



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CURRENT STATUS OF CARDIAC ARREST

In Korea, the number of out-of-hospital cardiac arrests (OHCAs) increased from 27,823 in 2012 to 33,034 in 2024, corresponding to 64–68 cases per 100,000 population. The survival-to-discharge rate after OHCA was 9.2%, and the rate of favorable neurological outcome was 6.3%. Among patients with shockable rhythms, the survival-to-discharge rate was 44.9%, and among witnessed patients with shockable rhythms, it was 49.5%. Bystander cardiopulmonary resuscitation (CPR) was performed in 30.3% of cases in 2024. When bystander CPR was provided, the survival-to-discharge rate was 14.4% and the rate of favorable neurological outcome was 11.4%, whereas without bystander CPR, these rates were 6.1% and 3.5%, respectively; thus, survival and favorable neurological outcomes were 2.36- and 3.26-fold higher, respectively, when bystander CPR was performed [1]. Despite global efforts, survival after OHCA remains below 10% even in medically advanced countries. A recent meta-analysis reported a global mean survival-to-discharge rate of 8.8% and a mean 1-year survival rate of 7.7% after OHCA [2].

CHAIN OF SURVIVAL

Because OHCA is difficult to predict and typically occurs outside medical facilities, its management involves not only healthcare professionals but also laypersons, such as witnesses or first responders. Survival depends on the seamless and efficient linkage of time-critical actions, ranging from recognition of cardiac arrest and activation of the emergency medical services (EMS), to bystander CPR, use of an automated external defibrillator (AED), on-scene treatment by emergency medical personnel, advanced life support in the hospital, intensive care after return of spontaneous circulation (ROSC), and subsequent rehabilitation and recovery.

The chain of survival refers to the essential sequence of actions required to resuscitate a person in cardiac arrest. According to the 2025 guidelines, it consists of five elements. The first step, "recognition of cardiac arrest and activation of the EMS," involves a witness identifying cardiac arrest and promptly calling for help. The second step, "bystander CPR," consists of immediate initiation of CPR after EMS activation. The third step, "(automated) defibrillation," involves delivery of defibrillation using an AED or a similar device. The fourth step, "advanced life support and post-cardiac arrest care," includes provision of advanced life support by EMS personnel in the prehospital setting, depending on patient status, such as defibrillation, medication administration, and advanced airway management, followed by integrated post-cardiac arrest care after ROSC, including treatment of the underlying cause of arrest, intensive care, targeted temperature management, coronary intervention, and neurological prognostication. The fifth step, "rehabilitation and recovery," provides medical and social support to enable survivors to undergo rehabilitation and return to daily and social life (Fig. 1).

The chain of survival is a fundamental prerequisite for survival after cardiac arrest, and its quality is a key determinant of improved outcomes. In regions where a chain of survival is not established, meaningful survival after cardiac arrest is unlikely. Conversely, establishing a robust chain of survival and strengthening each link improves overall survival. In one region of the Netherlands, enhancements in the quality of the chain of survival, including dispatcher-assisted CPR, AED use by first responders, and the use of mechanical chest compression devices and endotracheal intubation by EMS personnel, increased the 1-year survival rate after OHCA to 27% [3]. Efforts to improve survival through systematic strengthening of the chain of survival may therefore provide valuable guidance for improving cardiac arrest outcomes in Korea.

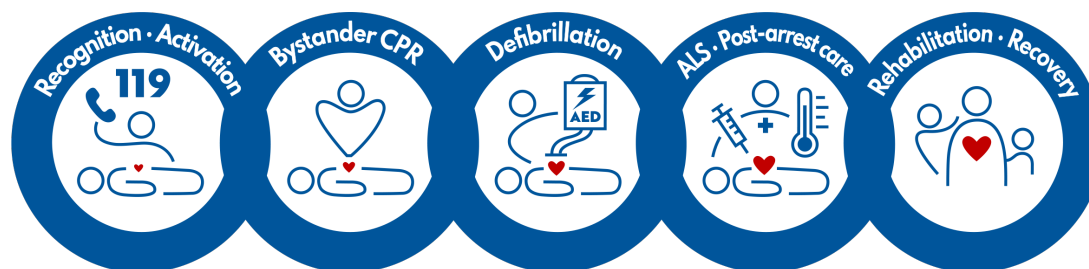


Fig. 1. Chain of survival. The chain of survival refers to a series of interventions that must be provided to maximize survival after cardiac arrest. It begins with a witness recognizing cardiac arrest and activating the emergency response system (e.g., calling 119), and continues with immediate bystander cardiopulmonary resuscitation (CPR), defibrillation using an automated external defibrillator (AED), advanced life support (ALS) by emergency medical service providers, post-cardiac arrest care in the hospital, and rehabilitation and recovery for survivors.

Recognition of cardiac arrest and activation of the EMS

The chain of survival begins when a witness recognizes cardiac arrest and activates the EMS by calling for help (contacting the 119 EMS system). When cardiac arrest occurs, clinical signs such as loss of consciousness, apnea, and pulselessness are typically present; however, abnormal breathing (agonal respirations or rapid breathing) or convulsions may also occur in some cases [4,5]. Because transient breathing efforts or seizure-like activity can persist after cardiac arrest, lay witnesses may have difficulty determining whether cardiac arrest has occurred [6,7]. Delayed recognition of cardiac arrest leads to delays in EMS activation and initiation of CPR. An analysis of Korean data showed that each 1-minute delay in recognition was associated with a 9% decrease in the likelihood of favorable neurological recovery [8].

Educating laypersons about the clinical signs of cardiac arrest, including agonal breathing, and training dispatchers to use structured questions regarding these signs can shorten the time to recognition and improve recognition rates [9,10]. Efforts are also underway to incorporate artificial intelligence and machine learning into emergency call center systems to enhance dispatcher recognition of cardiac arrest [11]. To promote early recognition, CPR training curricula should include instruction on the clinical signs of cardiac arrest, and dispatchers should be trained to support recognition through structured questioning during emergency calls. In hospitals, the use of early warning score systems and the operation of rapid response teams are recommended to prevent and respond to in-hospital cardiac arrest [12,13].

Bystander CPR

Each 1-minute delay in initiating chest compressions reduces the probability of a favorable neurological outcome after cardiac arrest by 13% [14]. Survival after cardiac arrest is up to approximately four times higher when bystander CPR is performed than when it is not [15]. Community-level interventions, such as dispatcher-assisted CPR, public awareness campaigns on cardiac arrest and CPR using mass media and social media, and CPR training for residents, can increase the rate of bystander CPR [16,17]. To improve survival after OHCA, all communities should implement public awareness and education programs related to cardiac arrest and CPR.

In comparisons between compression-only CPR (chest compressions without rescue breaths) and standard CPR (including ventilation) for OHCA, no difference in survival has been observed between the two approaches [18]. Teaching compression-only CPR may reduce reluctance to attempt CPR due to aversion to mouth-to-mouth ventilation and facilitate rapid dissemination

because it is easier to learn. However, healthcare providers and laypersons who are willing and able to provide ventilation should perform standard CPR, including rescue breaths.

In in-hospital cardiac arrest, initiation of CPR within 1 minute, regardless of the arrest rhythm, is associated with higher survival-to-discharge rate and better neurological outcomes [19]. All hospital staff should be trained to deliver high-quality CPR, and the need for advanced life support training should be determined according to the individual's clinical role.

Defibrillation

With the widespread availability of AEDs, laypersons can now deliver defibrillation in out-of-hospital settings. Layperson defibrillation improves survival-to-discharge and neurological outcomes, and its benefit is greater when EMS arrival is delayed [20]. Expanding AED deployment increases the rate of layperson defibrillation and shortens the time to defibrillation [21].

An analysis of Korean data showed that only 0.7% of witnessed cardiac arrest patients received AED defibrillation in addition to bystander CPR [22]. Moreover, a survey of AED maintenance revealed that 15.4% of AEDs were not immediately usable and that 44% were not available 24 hours a day [23]. Strategies to increase AED use should include raising public awareness of the importance of AEDs, strengthening education and skills training, expanding and optimizing AED placement, and improving maintenance to ensure 24-hour availability. In addition, notifying trained first responders via text message or social media of the occurrence and location of cardiac arrest, as well as nearby AED locations, can shorten the time to defibrillation and increase defibrillation rates [24].

In Korea, where laws mandate AED installation in public places, including multiuse facilities, and in residential settings, public access defibrillation programs should be expanded to systematize AED dissemination and maintenance and to promote use.

In hospitals, enabling ward nurses to perform defibrillation before the resuscitation team arrives can improve survival after cardiac arrest [25]. Therefore, hospitals should place AEDs in locations that allow rapid access during cardiac arrest and should train staff accordingly.

Advanced life support and post-cardiac arrest care

Advanced life support (ALS) comprises interventions designed to achieve ROSC, including establishment of intravenous or intraosseous access, medication administration, defibrillation, advanced airway management, and extracorporeal CPR (ECPR). It also includes comprehensive post-cardiac arrest care after ROSC, such

as intensive care unit management, targeted temperature management, diagnostic evaluation to determine the cause of cardiac arrest (e.g., coronary angiography, computed tomography, and echocardiography), etiologic treatment, and neurological prognostication.

In the management of OHCA, prehospital EMS providers deliver ALS within the scope permitted by law, including medication administration, defibrillation, and advanced airway placement. Because the effect of prehospital ALS on OHCA survival remains controversial, close medical oversight is recommended when ALS is provided in the field [26,27]. Resuscitation during transport of patients with OHCA has been associated with lower survival to hospital discharge than continued resuscitation on scene [28]. However, because EMS organization and capabilities vary across countries and regions, decisions regarding on-scene versus transport resuscitation should be based on the local EMS context.

In hospitals, more ALS is delivered by specialized resuscitation teams and includes defibrillation, medication administration, invasive and noninvasive monitoring of CPR quality, use of point-of-care diagnostic tools such as transesophageal echocardiography, and ECPR.

After ROSC, patients should receive intensive care, coronary angiography when indicated, diagnostic testing to identify the cause of arrest, and comprehensive post-resuscitation care for post-cardiac arrest syndrome. If consciousness does not recover after completion of post-cardiac arrest care, neurological prognostication should be performed using physical examination findings, laboratory tests, electrophysiologic studies, and neuroimaging. For specialized and comprehensive cardiac arrest care, dedicated cardiac resuscitation centers are required and should be capable of providing 24-hour intensive care, targeted temperature management, ECPR, coronary angiography with percutaneous coronary intervention, and multimodal prognostic testing [29,30].

Rehabilitation and recovery

Long-term cognitive impairment occurs in approximately half of cardiac arrest survivors, and about one in five experiences neuropsychiatric sequelae, including memory decline, executive dysfunction, anxiety, and depression [31,32]. Among patients with refractory cardiac arrest who received CPR until hospital arrival and survived for more than 30 days, 73% were able to return to work despite post-cardiac arrest sequelae [33].

Multidisciplinary rehabilitation programs that integrate psychological, cognitive, and medical support improve neurological, mental health, and functional outcomes in cardiac arrest survivors

[34]. Because these survivors differ from other patient populations with respect to underlying conditions and neurological sequelae, successful return to daily and social life requires not only medical care but also support from family and society. Therefore, structured discharge planning and implementation based on medical and functional assessments are necessary and should include rehabilitation, recurrence prevention, medical follow-up for neurological sequelae, and support for social reintegration [35,36]. In Korea, research on neurological outcomes, rehabilitation effectiveness, and social reintegration among cardiac arrest survivors remains limited. Greater medical and societal attention, along with systematic data collection and dedicated research efforts, is needed in this area.

CARDIAC ARREST TREATMENT SYSTEM AND THE ENVIRONMENT FOR CARDIAC ARREST SURVIVAL

A cardiac arrest treatment system (CATS) is a sociomedical framework that encompasses not only medical facilities, specialized personnel, equipment, and organizations for cardiac arrest care, but also all associated human and nonhuman resources, support mechanisms, policies, and institutional structures [37]. The CATS includes components related to on-scene emergency care and transport, in-hospital care encompassing ALS and post-cardiac arrest management, and rehabilitation and recovery. Establishing a CATS is essential for implementing the chain of survival. Within such a system, the likelihood of survival increases when patients receive continuous, coordinated care across each link of the chain. Therefore, each community should establish and maintain a CATS to support the chain of survival within its region.

Reducing deaths from cardiac arrest requires communities to integrate both medical (prevention, treatment, rehabilitation, and recovery) and nonmedical elements (public awareness, CPR education and bystander CPR performance, AED availability, and EMS responsiveness). The "environment for cardiac arrest survival" refers to the societal infrastructure that maintains, supports, and optimizes these medical and nonmedical components to reduce cardiac arrest mortality, spanning prevention through treatment and rehabilitation [37]. National and local communities should minimize cardiac arrest-related deaths by establishing an efficient CATS and a supportive survival environment, complemented by continuous monitoring and improvement of each component.

The 2025 CPR guidelines recommend the following priorities to establish a CATS and an environment for cardiac arrest survival that can improve outcomes.

Systematic management of the CATS and survival environment

With annual cardiac arrest deaths exceeding 30,000 in Korea, policy and institutional governance are essential to reduce this burden. National and local governments should establish dedicated cardiac arrest management organizations to maintain the CATS and survival environment. These organizations should increase public awareness of cardiac arrest and CPR, maintain a cardiac arrest registry, provide systematic CPR education, disseminate and manage AED programs, oversee quality management of EMS personnel, the EMS system, and medical institutions within the CATS, and coordinate care for cardiac arrest survivors.

To enhance CATS effectiveness, quality management, including monitoring, evaluation, and improvement of cardiac arrest care processes and outcomes, is required. Communities should select performance indicators to assess system performance, including outcome indicators such as ROSC, survival rates, and survival with favorable neurological outcomes, as well as process indicators such as CPR training program coverage, bystander CPR rates, AED usage, ambulance response times, EMS resuscitation performance during on-scene CPR, and in-hospital resuscitation measures. Target values should be set, and indicators monitored periodically. Continuous evaluation and improvement require personnel, financial resources, and coordination with relevant agencies.

Hospitals should also monitor in-hospital resuscitation quality indicators, including rapid response team activity, staff CPR training completion, CPR performance, implementation rates of in-hospital cardiac arrest interventions, and survival with favorable neurological outcomes.

Improving public first aid capacity for cardiac arrest response

In most OHCA, the first witness is a layperson, such as a family member, coworker, or passerby, and the witness's initial actions, including recognition of cardiac arrest, CPR, and AED use, critically influence survival. Just as the public is trained to respond immediately to fires, all citizens should be instructed in basic life support, including initial steps for cardiac arrest response, to enhance public readiness.

Internationally, CPR organizations conduct campaigns and events, such as Kids Save Lives, World Restart a Heart, and CPR Awareness Week, to raise awareness and promote CPR training, and advocate for legislation to institutionalize CPR education [38,39]. In Korea, although many citizens are already designated as CPR training targets under laws such as the Emergency Medical Service Act, the School Health Act, and the Act on Rescue and

Emergency Medical Services, additional training infrastructure and instructors are needed to improve CPR education quality. National and local governments should assess current public first aid training, implement institutional improvements, and provide financial support to enhance training effectiveness.

Increasing the rate of bystander CPR

Bystander CPR is a critical link in the chain of survival for OHCA. In Korea, the bystander CPR rate was 30.3% in 2024, which is lower than rates in the United States (39.2%) and Japan (57.0%), and regional variation is substantial, ranging from 14.8% to 50.9% [40].

Multiple factors influence whether a witness performs CPR. Barriers include panic upon discovering cardiac arrest, lack of prior CPR training, fear of causing harm, CPR education without hands-on practice, and residence in socioeconomically disadvantaged areas. Factors that increase the likelihood of performing CPR include hands-on training, higher educational attainment, compression-only CPR, recent CPR education, and community-based training programs [41]. To improve bystander CPR rates, public awareness campaigns should emphasize cardiac arrest recognition and CPR importance, including Good Samaritan protections, through mass media and social media, alongside hands-on training, repeated refresher courses, and community-based skill dissemination.

Efficient dissemination and use of AEDs

AED use is the most critical component of prehospital treatment for ventricular fibrillation. Survival rates are 1.75 to 1.98 times higher when an AED is used, and increasing AED availability leads to higher utilization [42,43].

In Korea, AEDs are applied in fewer than 3% of public cardiac arrests [40]. Increasing AED use requires efficient deployment, routine maintenance, and user education. Cardiac arrest incidence data can inform spatiotemporal optimization models for AED placement, accounting for regional cardiac arrest patterns, geographic characteristics, witness response, and EMS capabilities [44,45]. Korea should develop and implement AED dissemination, placement, and maintenance strategies tailored to local contexts.

Among public AEDs, 44.1% are unavailable 24 hours a day due to expired pads, mechanical errors, locked cabinets, or indoor installation [23]. In addition to strategic deployment, improving maintenance, unlocking cabinets, and installing AEDs in accessible outdoor locations are necessary to ensure round-the-clock availability.

Strengthening the role of EMS dispatchers

EMS dispatchers play a pivotal role in cardiac arrest emergencies by assisting with cardiac arrest recognition, guiding dispatcher-assisted CPR, and facilitating AED use. Often, cardiac arrest is identified during the emergency call rather than directly by the witness. However, dispatcher recognition of cardiac arrest varies considerably, with particular difficulty in assessing patient breathing by phone [46,47]. Dispatchers can increase bystander CPR rates by providing real-time instruction, and video calls can enhance CPR quality [48]. Standardized protocols and dispatcher-guided CPR programs are recommended to reduce the time to CPR initiation [49].

Dispatcher support also improves AED use and defibrillation rates [50]. Dispatchers can direct rescuers to AED locations and guide device operation. Notifying trained volunteers near the arrest site via text messages or social media to bring an AED can shorten the time to defibrillation, increase defibrillation rates, and improve survival [24,51]. Dispatchers require structured training and system support to provide cardiac arrest recognition, dispatcher-assisted CPR, and AED guidance effectively.

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Author contributions

Conceptualization: SOH; Investigation: all authors; Funding acquisition: SPC; Project administration: SPC, YJ; Writing—original draft: SOH; Writing—review & editing: all authors. All authors read and approved the final manuscript.

Conflicts of interest

Sung Oh Hwang, Chun Song Youn, Mi Jin Lee, Jisook Lee, and Sung Phil Chung are editorial board members of this journal, but were not involved in the peer reviewer selection, evaluation, or decision process of this article. The authors have no other conflicts of interest to declare.

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Data availability

Data sharing is not applicable as no new data were created or analyzed in this study.

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