

Out of hospital cardiac arrest, first steps to know and follow in Mexico to have cardioprotected territories. A point of view of a group of experts

Paro cardíaco extrahospitalario, primeros pasos que se deben conocer y hacer en México para tener espacios cardioprottegidos. Punto de vista de un grupo de expertos

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Abstract

Sudden cardiac death is a common occurrence. Out-of-hospital cardiac arrest is a global public health problem suffered by ≈ 3.8 million people annually. Progress has been made in the knowledge of this disease, its prevention, and treatment; however, most events occur in people without a previous diagnosis of heart disease. Due to its multifactorial and complex nature, it represents a challenge in public health, so it led us to work in a consensus to achieve the implementation of cardioprotected areas in Mexico as a priority mechanism to treat these events. Public access cardiopulmonary resuscitation (CPR) and early defibrillation require training of non-medical personnel, who are usually the first responders in the chain of survival. They should be able to establish a basic and efficient CPR and use of the automatic external defibrillator (AED) until the emergency services arrive at the scene of the incident. Some of the current problems in Mexico and alternative solutions for them are addressed in the present work.

Keywords: Sudden cardiac death. Automatic external defibrillator. Cardio-pulmonary resuscitation. Legislation. Out-of-hospital cardiac arrest. Cardioprotected areas.

Resumen

La muerte súbita cardíaca (SCD) es un acontecimiento común. El paro cardíaco extrahospitalario (OHCA) es un problema de salud pública mundial que sufren ≈ 3.8 millones de personas al año. Se ha avanzado en el conocimiento de esta enfermedad, su prevención y tratamiento, sin embargo, la mayoría de los eventos se producen en personas sin diagnóstico previo de cardiopatía. Debido a su carácter multifactorial y complejo, representa un reto en salud pública, lo que obliga a trabajar en un consenso para lograr la implementación de "Espacios Cardio protegidos" en México, como mecanismo prioritario de atención a estos eventos.

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La reanimación cardiopulmonar básica (RCPB) y la desfibrilación temprana de acceso público requieren de entrenamiento al personal no médico, que suelen ser los primeros respondientes para iniciar la cadena de la supervivencia. Ellos deberían instaurar una RCPB eficiente y el uso del desfibrilador automático externo (AED) hasta que lleguen al lugar del incidente los servicios de emergencias. El presente trabajo menciona algunos de los problemas actuales en México y algunas opciones de solución para los mismos.

Palabras clave: Muerte súbita cardíaca. Desfibrilador externo automático. Reanimación cardiopulmonar. Legislación. Paro cardíaco súbito extrahospitalario. Espacios cardioprottegidos.

The initial problem

Out of Hospital Cardiac Arrest (OHCA) is a world health problem¹: it is calculated that Sudden Cardiac Death (SCD) represents 30% of the mortality of cardiovascular origin, and 20% of total cause of death in the adult²⁻⁴. The real incidence is hard to determine and may vary in each country. However, in countries as the United States of America or in some European states, it's incidence is calculated between 41 and 155 cases for every 100,000 inhabitants yearly in the population older than 45 years⁵⁻⁷. This incidence is 10 times less frequent in younger patients⁸. The survival rate is very low depending on the population studied.

It is of vital importance to have a survival chain. This implies a simple and useful conceptual method that requires coordination in each of the actions to employ. To successfully perform cardiopulmonary resuscitation (CPR) during an OHCA, the role of the community is paramount, since CPR trained lay-persons can initially detect, notify the emergency system of the CPR in process and, if necessary, use the Automated External Defibrillator (AED)^{9,10}. The importance of the knowledge of basic CPR (BLS) is here enhanced for the general population. This is because, most frequently, the first responder to an OHCA is not a health-care professional¹¹.

The need for a national registry of OHCA (RENAPACE)

In Mexico, as in the rest of the world, cardiovascular disease is the first cause of death or at least, among the five first causes. Out of these, ischemic heart disease due to atherosclerosis is the most important in adults^{12,13}. Recent official statistics reported by the National Institute of Statistics, Geography, and Informatics showed an overall mortality close to 20% due to cardiovascular disease, not gender related. During the period comprised from the 1st week of 2020 to the week 25 of 2021, the mortality expected due to cardiovascular disease was 232,658 cases. However, the

increase in mortality from heart disease is directly related to the risk factors of each patient. Many dead patients, 70% of them, had at least one major risk factor such as diabetes mellitus, hypertension, dyslipidemia, tobacco use, obesity, or sedentarism¹⁴. Even though the incidence of OHCA among the general population (with or without risk factors) is relatively low, the absolute number of events is much higher when compared to pathologies with a high incidence of sudden death such as dilated cardiomyopathy, channelopathies, aortic stenosis, and others^{15,16}.

One of the few reports of annual mortality due to OHCA in Mexico is an estimation from 2004 of 33,000-55,000 annual deaths¹⁷. There is scarce information in Mexico about SCD or OHCA and their follow-up; thus, there are no satisfactory data concerning constant improvement of the systems that respond to OHCA, neither about hospital cardiac arrest¹⁸. Hence, this is a public health problem that has been underestimated. However, with the intervention of diverse organisms of the government and nongovernmental agencies such as police, emergency responders, hospitals, community county, state governments, and medical societies, there can be a promising outcome, that is to prevent deaths in patients which are still in a productive age¹⁸⁻²¹.

Unfortunately, Mexican authorities lack specific terms to be used in the death certificate such as "SCD." Diagnosis of Acute Myocardial infarction is use as a synonym of sudden death even in previous young health people. This means that there is a lack of precise statistics, and thus, SCD is unaccounted for, making it impossible to evaluate its real impact and leading to a certain invisibility^{21,22}.

Death certificates should allow the possibility to diagnose "SCD" as cause of death, to use them as a tool to better evaluate health needs, basic needs for investigation, planification, and follow-up of public policies. Therefore, SCA should be allowed in death certificates as a direct cause (most frequent) instead of "acute myocardial infarction" (IAM), cardiac failure, or others

that might lead to misinterpretations²². It should be, then, a priority to have a national registry of OHCA such as RENAPAGE, that can be obtained from public municipal registries and, therefore, state registry. In this way, this public health problem, recognized mainly by a specific group of health-care professionals (cardiologists), can become a priority in public policies in Mexico (Fig. 1).

Problems in the performance of CPR by witnesses/bystanders

Lay-person CPR training should be a shared effort between health authorities, educational systems, medical associations, non-governmental organizations, and others that can be involved in the education and training of the general population in CPR as a requirement in places that hold large concentration of people. In a building, for example, at least 30% of the inhabitants should be trained in CPR. During events of more than 500 people in 24 h, an AED should be available within a 2-min distance. Such a facility could be considered as a “cardioprotected” space in case of an OHCA event. In Mexico, there have been several proposals and individual efforts to implement this concept (started in san Miguel Allende), without any legislation to the moment²³.

The vast majority of deaths by OHCA do not have the chance to be delivered to a hospital: death occurs, and the survival rate is below 5% at emergency room arrival. This percentage could possibly be increased up to 31% survival at 1 year after hospital discharge if the OHCA is treated by a non-medical witness (lay-person) trained in CPR and AED management²⁴. The survival rate has proven to be better if the victim receives CPR at the place of the collapse by a witness and is transferred afterward to hospital facilities. At the moment, the administration of CPR by a lay-person and the use of an AED could be as low as 4%²⁴.

General population training in CPR and use of AED

The survival of the patient of OHCA depends on the time between the cardiac arrest and the beginning of the CPR: The survival rate diminishes 10% for every delayed minute. This is the reason why immediate hands-only CPR is of great importance, regardless of who performs it²⁵. This is also why the participation of the witness of an OHCA to timely recognize a cardiac arrest, ask for help and an AED, and start CPR is of paramount importance.

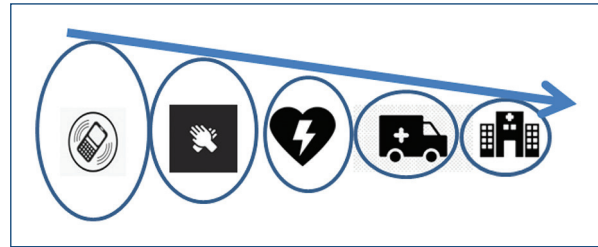


Figure 1. Impact and effect of the survival chain. Modified from Ong et al. *Out-of-hospital cardiac arrest: prehospital management. The Lancet, 2018;391(10124): 980-988.*

The role the community and the dispatch center

New technologies make possible for an emergency medical dispatch center (EMDC) to help lay responders find and bring the nearest AED to the scene of the cardiac arrest, if not present on site^{26,27}. A system to dispatch nearby lay responders either to public locations or to the home of the OHCA victim using mobile phone text messages for CPR performance and AED use has been successfully implemented^{27,28}. Agerskov et al.²⁹ found that a text message-reached responder attached an AED in 12% of all OHCA and defibrillation was carried out more than 2.5 min before the arrival of the EMS. It is also possible to use the information provided in AED registries and display AED locations on interactive maps to guide bystanders to the closest AED in case of a suspected OHCA^{30,31}. Unfortunately, only a very small proportion of cases receive directions to reach a nearby AED³². How could the number of AED needed in a population with a text message system response be determined? AED densities of $< 1/\text{km}^2$ have a negative effect on the time to first respond. More than 2 AED per km^2 might both improve probability for a text-message system AED to be earlier at the OHCA scene and thus, for an early defibrillation. However, densities above 10 AED per km^2 increase earlier (< 6 min) defibrillation³².

There are some other important factors such as “rescuer start-up delay,” finding and opening the AED box, and fixing electrodes on the chest. The aim to reduce time to shock by the text message system needs not only to concentrate on the AED but also on the text message responder availability as well³². The initial witness is the ideal person to start CPR efforts since it is the sole factor that has most impact on the survival

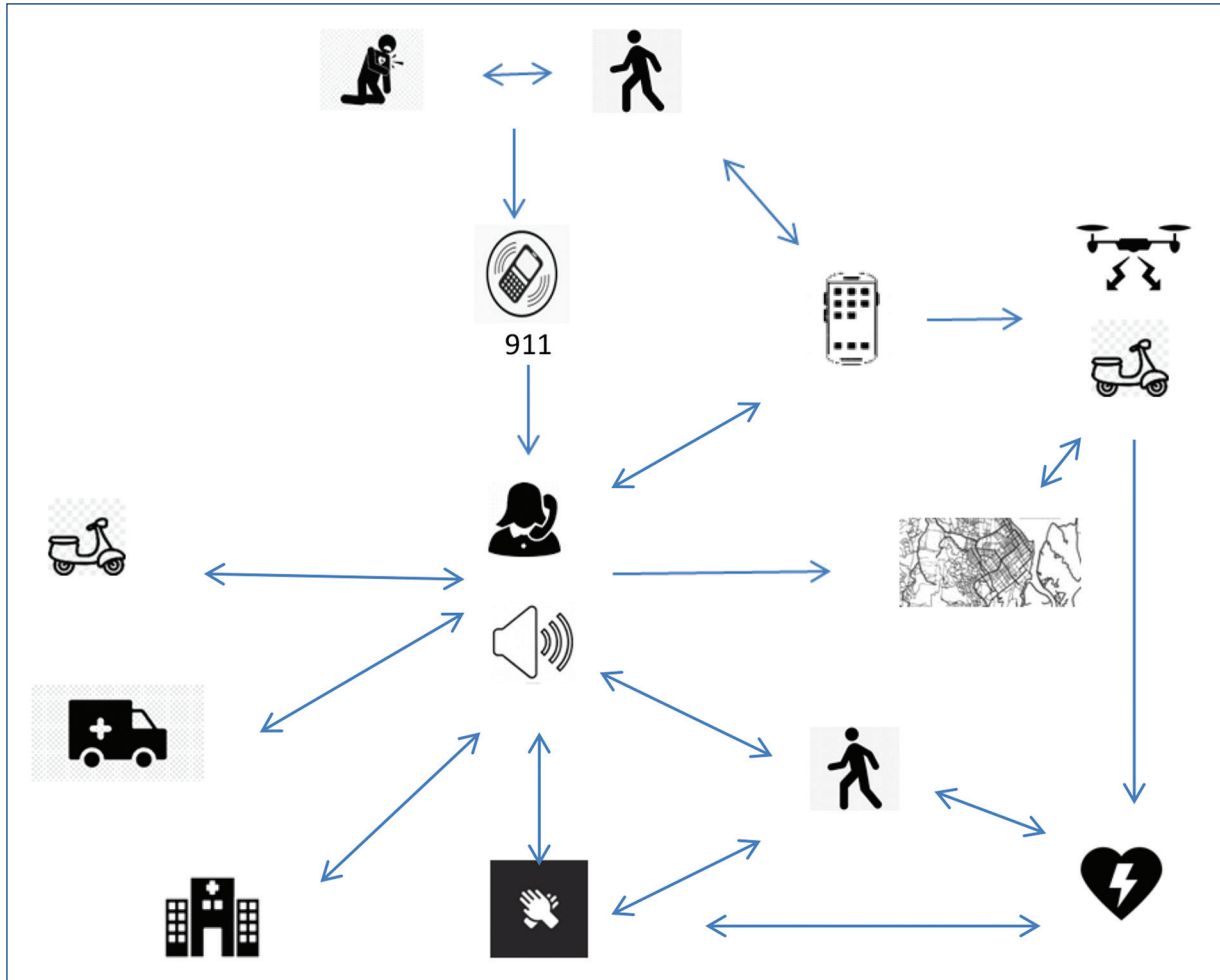


Figure 2. Dispatch center Flowchart.

rate of the victim. It has also been described the importance of a family member to witness and initiate CPR since it can be performed with more emphasis^{1,33}.

The dedicated EMDC is a relatively recent concept that plays a relevant role in the chain of survival³⁴⁻⁴⁰. The EMDC coordinates the response to an OHCA event. In Mexico, EMDCs are scarce but they are deemed to regulate medical emergencies through:

- Receive the emergency call from the witness in presence of OHCA.
- Guide the lay-person to conduct phone-assisted CPR.
- Use technology to geographically locate where the event is taking place (either by a cellular application or map, drones, etc).
- Indicate the place of the closest AED available and/or if possible, send one.

- Activate the emergency medical services to send an ambulance with advanced CPR capabilities.
- Coordinate with the ambulance and hospitals the patient's transfer to the nearest facility with adequate personnel and equipment for the attention of OHCA and facilitate communications between the paramedic team and the hospital's personnel that will receive the patient (Fig. 2).

Due to this dispatch center idea (EMDC), the concept of phone-assisted CPR has emerged (Dispatch assisted CPR or DA-CPR). This assistance may double the efficacy of the CPR started by a witness and has been simplified by the concept of hands only CPR³⁸, which, in turn, avoids delays in beginning CPR. It allows more people to assist with effective compressions, thereby giving better outcome results to the OHCA patient. One of the main purposes of the dispatch center is to help the witness differentiate between a real OHCA patient, or one with syncope or that does not require CPR^{39,40}.

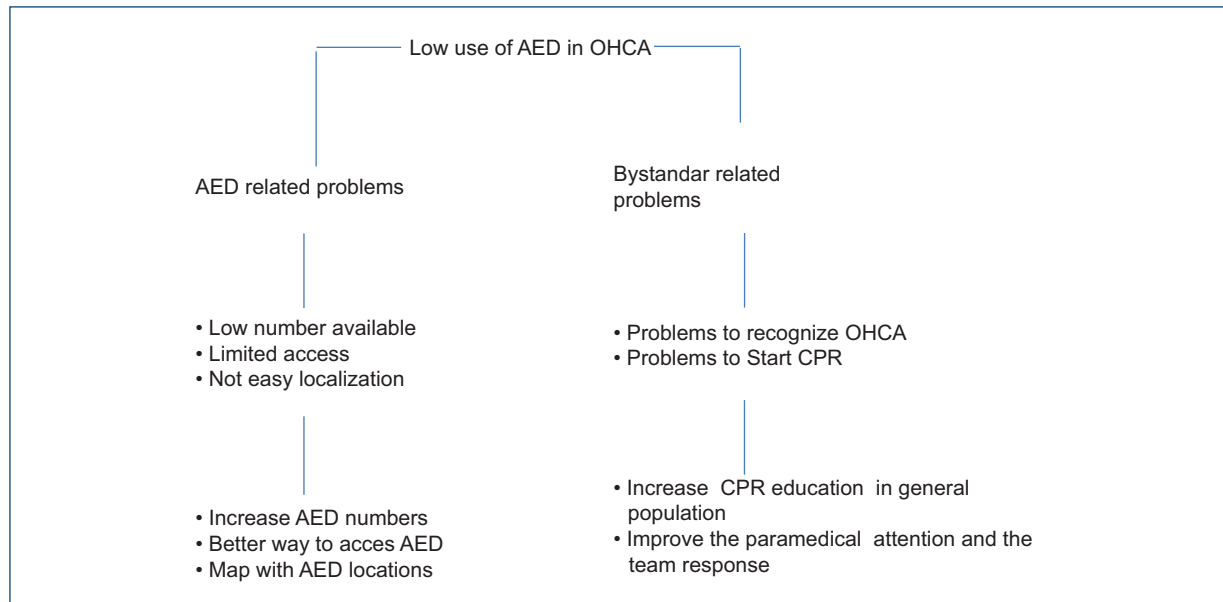


Figure 3. Causes of low use of EAD in out of hospital cardiac arrest.

Problems with the AED

The main problem to address is to have a readily available AED capable to differentiate between a defibrillatable rhythm that may improve with the use of an AED – such as a ventricular tachycardia without pulse or a ventricular fibrillation – or a non-defibrillatable one. Ideally, the AED should be available next to the victim within the first 2-min cycle of CPR or within the first 4 min after the OHCA event^{36,41}.

This implies the presence of a cardio protected area where the availability of an AED within reasonable distance and the presence of people among lay persons with knowledge of basic CPR and AED management. This is part of the main efforts yet to address. In Mexico, it is necessary to legislate in a way that an AED should be available within a 4-min delay at any venue that might accumulate more than 500 people. This “cardioprotection laws” could be suggested, advocated, and somehow regulated by non-governmental organisms and medical societies linked to cardiology⁴².

The possibility of emergency medical services response within a reasonable amount of time has narrowed the need for the dispatch center to detect which emergency medical center is closest for arrival to take care of the OHCA or to detect the closest AED. This one may even be located on a public site, like the first one to be installed in our country, in San

Miguel de Allende, Guanajuato, placed in a town’s square²³.

The latest technology has even made possible to deliver an AED’s by a drone in less time than an emergency medical service vehicle⁴³⁻⁴⁸. This, however, also requires a special legislation to allow the use of aerial space for this purpose (Fig. 3).

Usefulness of new technology

The newest technology available in our daily life, such as smart phones, tablets, GPS localizer, text messages, and video calls have facilitated the timely arrival of first responders to a case of OHCA⁴⁵. However, these efforts are not enough if there is not an AED available or if there is no registry of the closest one^{32,46-48}. Technology can improve the identification and location of the closest AED to a casualty, to facilitate the fastest access route or even its delivery through a drone, as was mentioned earlier⁴⁷⁻⁵⁰.

Strategies to implement the use of AED

- Geographical information about the occurrence of OHCA and the location of AEDs should be known to the EMDC. This information should also be available for political decision-makers to get public-available registries of both OHCA and AEDs.
- The call centers and AED registries should enable EMDC telecommunicators to guide the caller to the nearest accessible AED.

- The AED registries should be available for the public to increase awareness of AED locations within the community.
- Automatic external defibrillators should be accessible 24/7 or, with the accessibility periods clearly marked in the registry.
- Dispatchers should be continuously trained and audited in OHCA recognition, telephone-assisted CPR and aiding bystanders to retrieve and use the closest AED.
- Dual dispatch of first responders with AED's should be routine procedure for suspected OHCA. We suggest implementing additional system for AED retrieval by nearby lay responders using mobile phone positioning services.
- OHCA's should be analyzed with the aid of geographical information systems and other models using demographic data, to identify high-risk areas both in public and residential settings.
- Geographical Information Systems should also be used to match AED coverage with areas of increased risk of OHCA.

The most important challenge for the community is to be able to establish contact between the first responder of a case of OHCA and the closest available AED⁵⁰. The mere existence of AEDs in public places without the capacity to link these to the first responders makes this effort futile since it does not improve OHCA's victim survival because its use will still be delayed^{47,51}.

This requires a community education program integrated to the dispatch telephone center, who will have knowledge of the nearest available DAE, and if possible, being able to deliver it to the site of the OHCA. All these strategies imply economic investments of different magnitudes⁵²⁻⁵⁴.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical disclosures

Protection of humans and animals. The authors declare that no experiments on humans or animals were performed for this research.

Confidentiality of data. The authors declare that they have followed their center's protocols on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

Use of artificial intelligence for generating text. The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript, nor for the creation of images, graphics, tables, or their corresponding captions.

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