Results of the introduction of an automated external defibrillation programme for non-medical personnel in Galicia

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Abstract

Objectives: To describe the plan and development of a programme for the introduction of automated external defibrillation for non medical personnel and to report the results of the first 10 months of activity in a community which is predominently rural, such as Galicia. Methods: The plan for introduction of the project included aspects of logistics, training and control. We studied cardiac arrests, that were treated in basic life support ambulances (BLS-A) equipped with automated external defibrillators (AEDs), from 1st March to 31st December 2001. Results: Our community benefits from pioneering legislation in Spain. During the 10 months of study, 28 AEDs were in service, mostly in urban areas. In all cases, a thorough control of the quality of the service in which AEDs was used was carried out. 12% of the patients, who were victims of sudden cardiac death (SCD) and were found in ventricular fibrillation (VF), survived and were discharged from hospital. However, the percentage of patients found in VF is only around 26%. This is due to long assistance intervals (from the call to the arrival on site), and an important delay from the moment when circulatory collapse takes place until the emergency service 061 is called, more than 5 min in half the cases. Conclusions: The programme followed for the introduction of AEDs in Galicia was adapted to the socio-demographic characteristics of the population. The prehospital emergency assistance model was developed, executed and controlled by the Public Emergency Health Foundation of Galicia 061 (PEHF-061). The overall results of our first 10 months experience with the automated external defibrillation programme were as to be expected. In general, they are comparable to other published reports; however, ways of shortening the times from the point of collapse to defibrillation must be found, mainly by training the population and through the extension of automated external defibrillation provision to other first responders.

Keywords: Automated external defibrillation (AED); Out-of-hospital cardiac arrest (OHCA); Basic life support (BLS); Emergency medical technician (EMT)

Resumo

Objectivos: descrever o plano e desenvolvimento de um programa de introdução de desfibrilhação automática externa por não médicos e relato dos resultados ao fim de 10 meses de actividade numa comunidade que é eminentemente rural, como é o caso da Galiza. Método. O plano para introdução do projecto incluiu aspectos logísticos, de treino e controlo. Analisamos as paragens cardíacas ocorridas nas ambulâncias de suporte básico (BLS-A), equipadas com desfibrilhadores automáticos externos (DAE), de 1 de Março a 31 de Dezembro de 2001. Resultados. A nossa comunidade tem legislação que é pioneira em Espanha. Nos 10 meses do estudo, estavam ao serviço 28 DAE, na sua maioria em áreas urbanas. Foi feito em todos os casos um controlo detalhado da qualidade da utilização dos DAE. Das vítimas de "morte súbita" e encontradas em fibrilhação ventricular (VF), sobreviveram e tiveram alta hospitalar 12%. Contudo, só 26% dos doentes foram encontrados em VF. Tal deve-se ao longo período decorrido do pedido de ajuda à chegada ao local e ao longo período decorrido do colapso até que o pedido de ajuda chegue ao serviço de emergência 061, mais de 5 minutos em metade dos casos. Conclusões. O programa de introdução da DAE na Galiza foi adaptado às condições sócio-demográficas da população. O modelo de emergência pré-hospitalar foi desenvolvido, executado e controlado pelo

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Public Health Foundation of Galicia 061 (PEHF-061). Os resultados globais dos primeiros 10 meses de experieˆncia com DAE, esta de acordo com o esperado. Sa˜o, em geral, compara´veis com outros relatos publicados; contudo, devem ser encontradas formas de reduzir o tempo decorrido do ponto de colapso a` desfibrilhac¸a˜o, em particular treinando a populac¸a˜o e estendendo a disponibilidade de acesso a` DAE a outros sectores da popula¸ao.

Palavras chave: Desfibrilhac¸a˜o; Automa´tica externa; Paragem cardíaca pre´-hospitalar; Suporte ba´sico de vida Te´cnicos de emergeˆncia me´dica

Resumen

Objetivos : Describir el plan y desarrollo de un programa para la introduccio´ n de desfibrilacio´ n automa´tica externa para personal no me´dico y reportar el resultado de los primeros 10 meses de actividad en una comunidad que es eminentemente rural, como es el caso de Galicia. Me´todos El plan para la introduccio´ n del proyecto incluía aspectos de logística, entrenamiento y control. Examinamos los paros cardíacos, que fueron tratados en ambulancias de soporte vital ba´sico (BLS-A) equipadas con desfibriladores automa´ticos externos(AEDs), desde el 1 de Marzo hasta Diciembre 31 de 2001. Resultados : Nuestra comunidad se beneficia de ser pionero en legislacio´ n en Espa˜a. Durante los 10 meses de estudio, hab´ıa 28 AEDs en servicio, principalmente en a´reas urbanas. En todos los casos, se realizo´ un control estrecho de la calidad de el servicio en el que se uso´ el AED. El 12% de los pacientes, que fueron víctimas de paro cardíaco súbito (SCD) y fueron encontrados en fibrilacio´ n ventricular (VF), sobrevivieron y fueron dados de alta del hospital. Sin embargo, el porcentaje de pacientes encontrado en VF es solo cerca del 26%. Esto es debido a los largos intervalos de tiempo de asistencia (desde la llamada hasta la llegada al lugar), y a una demora importante demora desde el momento en que ocurre el colapso circulatorio hasta que se realiza la llamada a el servicio de emergencias 061 es mayor de 5 minutos en la mitad de los casos.Conclusiones El programa seguido para la introduccio´ n de AEDs en Galicia fue adaptado a las caracteísticas socio demogra´ficas de la poblacio´ n. El modelo de asistencia prehospitalaria fue desarrollado, ejecutado y controlado por la Fundacio´ n de Emergencias en Salud Publica de Galicia 061 (PEHF-061). Los resultados globales de la experiencia de nuestros primeros 10 meses del programa de desfibrilacio´ n automa´tica externa fueron como los espera´bamos. En general, son comparables con otros estudios publicados; sin embargo, deben encontrarse maneras de acortar los tiempos desde el punto de colapso hasta la desfibrilacio´ n, especialmente a trave´s de entrenar a la poblacio´ n y a trave´s de la extensio´ n de la provisio´ n de desfibrilacio´ n automa´tica externa a otros prestadores de primera respuesta.

Palabras clave: Desfibrilacio´ n automa´tica externa (DAEs); Paro cardíaco extrahospitalario; Soporte vital ba´sico(SBV); Te´cnicos en emergencias me´dicas

1. Introduction

The Public Emergency Health Foundation of Galicia-061 (PEHF-061), following the recommendations of various authoritative bodies [1,2] has promoted the use of automated external defibrillators (AEDs) [3] with the aim of improving survival in patients with out-of-hospital cardiac arrest (OHCA).

The ''chain of survival'' sets out the sequence of actions to achieve survival in cases of sudden cardiac death (SCD). In Galicia, the PEHF-061 has been strengthening the four links of the chain since its creation in 1995.

In accordance with the 1997 the recommendations of International Liaison Committee on Resuscitation (ILCOR) [4] on early defibrillation carried out by ambulance personnel, work was started in 1999 on the introduction of AEDs in all ambulances belonging to the emergency health transport network (EHTN) of the 061. These ambulances were staffed by two emergency medical technicians (EMT) able to carry out basic life support (BLS).

A course on automated external defibrillation was designed for the EMTs of the 061. The course follows the recommendations of the European Resuscitation Council concerning the number of hours of training and curriculum of the subjects to be taught. The course emphasises the need for rapid action and the importance of the chain of survival and each of its links. It includes a revision of BLS, the theoretical aspects of AED and, above all, practical case scenarios are carried out, related to cases that the student may have to face. Finally, there are knowledge evaluation tests, both theoretical and practical. There is also an obligatory annual retraining programme of 4 h to obtain recertification.

Steps were also taken to introduce appropriate legislation for working in the field. In October 2000, the Health Department of the autonomous government of Galicia approved legislation for the use of AEDs by non-medical personnel [5]. Galicia, consequently, became the first autonomous community in the nation that has legislation which regulates the use of AEDs by non-medical personnel.

Control systems were also developed, following the recommendations of ILCOR [4]. Currently, the 061 of Galicia controls all cases in which a AED is used in Galicia. This is possible because the defibrillators have

systems which record the electrocardiogram, the shocks administered to the patient, and the voices of the personnel involved in the resuscitation process of patients. All this data is processed by a computer and an events record is created for each case in which a AED is used. This enables the 061 to have overall control. Only those who have completed the course satisfactorily are accredited to use the AED. During AED use telephone contact is maintained between the EMT and the doctor at the Dispatch Centre. After use a medical record is created for each case and entered into a database, which is used for investigation and quality control.

2. Material and methods

The introduction of defibrillators in ambulances of the 061 service has taken place in various phases.The phases have been defined according to the criteria of the population, demand, resource mobilisation, level of training and work experience of the EMT at the EHTN bases, as well as the availability of other health resources in the area and their characteristics. The data presented below corresponds to the first phase.Details of all cardiac arrests in which an ambulance equipped with an AED was involved were collected from 1st of March to 31st of December 2001. 28 AEDs were in use during this first phase. Data was collected following the Utstein international style of data collection of cardiac arrest in an out-of-hospital setting [6].

Galicia is a community situated on the north west corner of the Iberian Peninsula. It covers 29 434 km^2, which makes up 5.83% of the total surface of Spain. The wide dispersal of the population together with its complex topography makes for prolonged ambulance transport times. Galicia had a recorded population of 2 695 880 inhabitants in 2001 (http://www.ine.es). In the year 2001, when this research study was undertaken, the Galician population served by ambulances equipped with AEDs was of 1 391 305, around half of the total population.

The emergency system is two-tiered, there are advanced life support ambulances (ALS-A) with a doctor, a nurse and two EMTs, and basic life support ambulances (BLS-A) with only two EMTs. The ALS-As are based in the seven main cities, which have an approximate population of 100 000 to 300 000. Besides the ALS-As there are two to four BLS-As in each city. Around the rest of the mainly rural community, 76 BLS ambulances are distributed to cover the population with a response time of 20 min. There is one Dispatch Centre in Galicia controlled by physicians dedicated to Emergency Medical Services with an emergency telephone number 061.

When a call is made from any of the seven cities where a cardiac arrest is suspected an ALS-A is activated. If the ALS-A is busy, a BLS is put into action. When a call is made from outside the cities a BLS ambulance is activated.

The procedures are as approved by the European Resuscitation Council [1] for the use of the AED, they also undertake BLS with a bag-valve-mask and manual chest compressions.The decision to halt the resuscitation process is left to a doctor from the ALS-A, the Galician Health Service; or the doctor at the Dispatch Centre, by phone.

The EMTs attend an initial 200 h course in techniques in pre-hospital assistance, highlighting BLS techniques. To be able to operate the AED, a specific course must be passed as well as annual refresher courses.

In reporting our findings, we have considered as urban those operations undertaken by the BLS-A in the seven main cities with their municipal districts, and report the rest as rural operations.

The average response time from the call to arrival of the BLS team with the patient is 10 min 27 s in urban areas, and 14 min 24 s in rural areas.

Times are set from both the Dispatch Centre clock and the clock within the AED on a monthly basis. The interval between the moment of collapse to making the phone call to 061 is estimated after interviewing witnesses.

Analysis of the initial rhythms was made according to the details recorded in the memory card of the AED. Both asystole and fine ventricular fibrillation (VF) that the AED did not consider appropriate to defibrillate, were considered asystole. There were no cases of pulseless electrical activity.

3. Results

The first phase ended in March 2001 when 28 AEDs were functioning in different areas * 17 in urban areas and 11 in rural areas. The second phase ended in February 2002, with 30 new AEDs and the third phase has ended in February 2003 with the last 35 AEDs. These results refer to the first stage of the programme.

Table 1
Students on AED courses

	EMT	External[a]	First recycling course
2000	286		
2001	400	238	93
Total	686	223	93
Pass	652	223	93
%	95.04	93.69	100

[a] Doctors, nurses and non-medical personnel from the Primary Health Care System.

Data of the students taking AED courses are depicted in Table 1. During the years 2000 and 2001, 652 EMT passed the course, and 93 undertook their refresher course.

During the 10 months of this study EMTs made 170 resuscitation attempts, out of which eight (4.7%) were later considered to be non-cardiac in origin. 57% of the resuscitations were undertaken in urban areas and 43% in rural areas. As in other reported series, most of the cardiac arrests occurred in the home. The details are displayed in Fig. 1.

Fig. 2 depicts the patients age; most are in the 60 80 age group. The ages extend from 23 to 94.

The eight patients with arrest of non-cardiac origin were not studied further. None of them showed a shock rhythm, there were no survivors and all died in the field. Of the 162 patients with cardiac aetiology, 44 were not witnessed (27.2%) and no cardiac arrest was witnessed by ambulance personnel. Out of the 102 cases with a cardiac origin, 60 were found in asystole and 42 in VF. Though a temporary return in spontaneous circulation was achieved in five cases with asystole as the initial rhythm, none of these patients were taken to an intensive care unit (ICU). Of the 42 patients with witnessed cardiac arrest in VF, a return of spontaneous circulation was achieved in 34; 11 were taken to the ICU and 5 were discharged alive and were still alive after 1 year. The Utstein Template is shown in Fig. 3.

The time analysis is summarised in Table 2. There are two important points to be noted. Firstly there was a 5 min delay in half of the cases from the time of call to contact made with the Emergency Medical System. Secondly there is an average of 12 min delay from the call to the first shock, which reflects the longer distances, especially in rural areas.

93 cases (57.4%) were responded to by the ALS-A teams. The five survivors were initially taken care of by technicians and then by the doctors from the ALS-A team.

4. Discussion

Emergency Medical Systems must adapt to their geographical and socio-economical environment. In

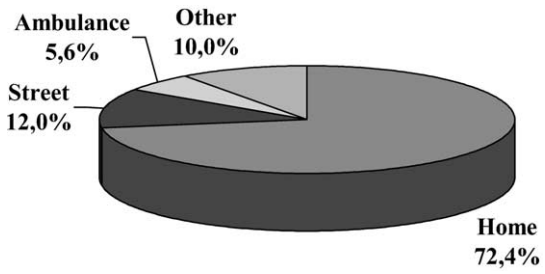

Fig. 1. Site of cardiac arrest.

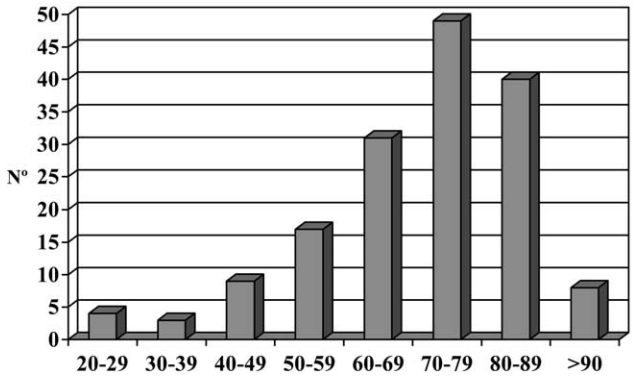

Fig. 2. Age.

Galicia, where the population is widely dispersed, the PEHF-061 adopted a mixed system. It has ALS-A led by doctors in the seven main cities of the Community and 93 ambulances with EMTs who are able to carry out BLS and early defibrillation with AEDs.

The results are as might be expected [7,9] in a region which is predominantly rural with a widely dispersed population and long response times.

Tables 3 and 4 show a summary of the results of arrests managed with AEDs by the 061 in the year 2001. These can be compared with different emergency systems from different areas, previous studies [10 23] and results from 061 ALS-A (ambulances with a physician, qualified nurse, two EMTs, and advanced life support). The ALS-A teams found more patients in VF because these vehicles only work in urban areas and have a shorter call-to-shock times than the BLS ambulances. Their survival figures range from 3.3 to 12.3%, varying between the seven important cities.

What stands out is the low percentage of patients found in VF, be it in ALS-A or BLS/AED ambulances. This relates to the long interval from SCD to the time patient is reached with a defibrillator. This interval can be divided into the interval from SCD to activation of 061, the interval from the call to the moment the ambulance sets off, and the interval from the moment the ambulance sets off to when it arrives at the scene. According to our data, half of the people take more than 5 min to make a call, a significant delay which influences our results and which, compared with other cities, can explain the low percentage of VF. In Amsterdam [15] 75% of people call in less than 2 min and in Seattle [12] the average time interval from moment of collapse to the call is 2.2 min. On the other hand, in Hong Kong [20], with an even lower percentage of VF than that registered in our data, the average time interval for the call in patients who did not survive was 8.79 min. The intervals between the call and arrival at the scene of BLS/AED ambulances are longer than those of medical ambulances. This is to be expected given the more widespread rural area in which BLS ambulances have to work

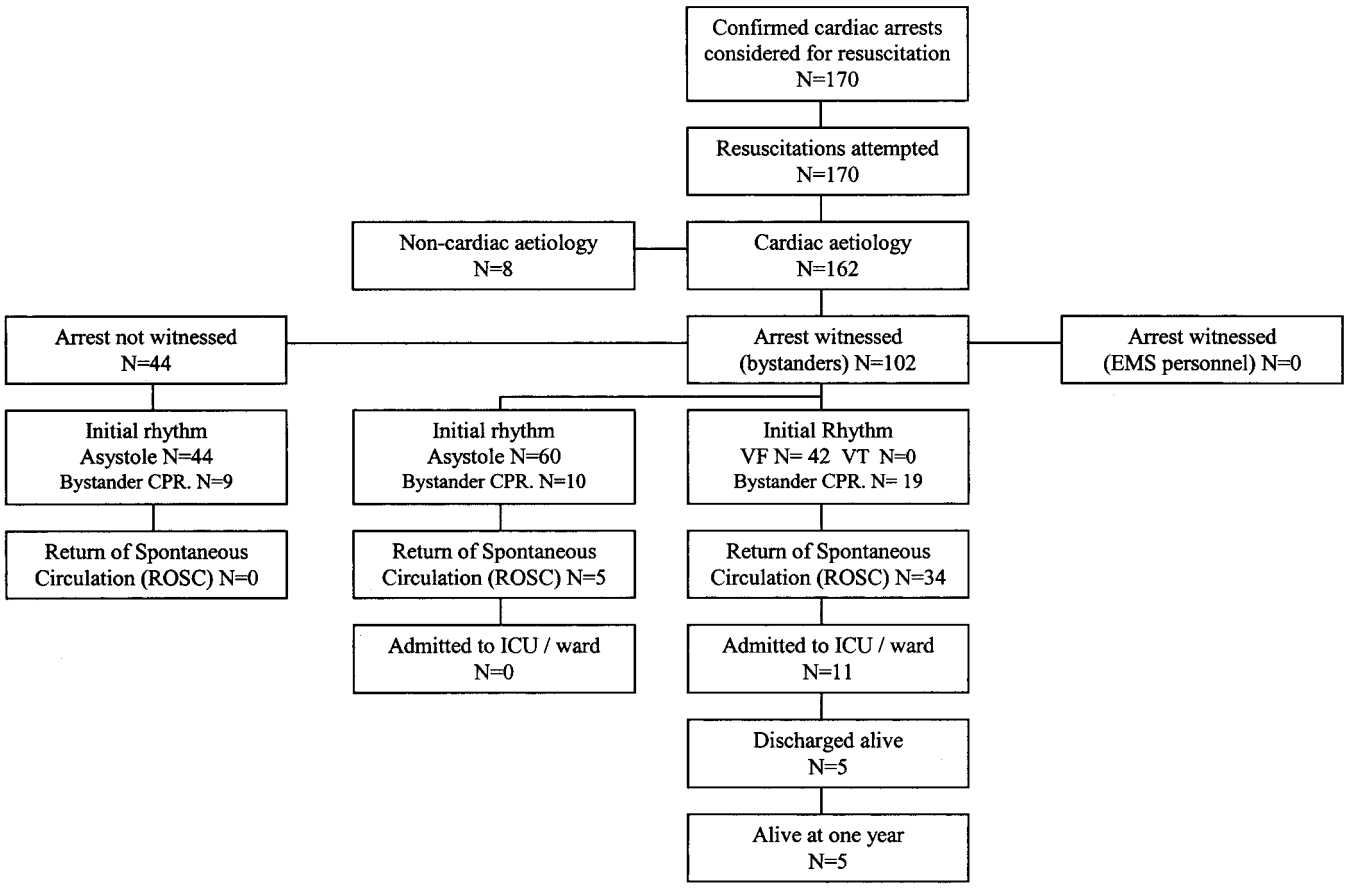

Fig. 3. Utstein template.

Table 2
Time analysis

Times (min) percentiles	p25	p50	p75
Collapse * call receipt	2	5	10
Call receipt * vehicle stops	5	10	18
Call receipt * first shock	6	12	15
Collapse * first shock	10	15	18
Collapse * first CPR-EMS personnel	10	16	23

environment; but both intervals are longer than others which have been published.

Another factor that should be considered is the percentage of patients who received BLS from bystanders (% BLS bystander). This percentage is similar to that of other rural areas and lower than that of urban areas. This can be improved in the future by implementing BLS courses among the population, for example at schools or when a person obtains their driving licence, as is the case in Bonn [19].

Lastly, we have to mention that survival of our patients found in VF (12%) is similar to that of other rural areas such as Iowa (19%), Minnesota (7.4%), Wisconsin (11%), but our overall survival of 2.3% is low due to our low rate of finding patients in VF.

Four out of every five survivors were treated by ambulances from rural areas. These ambulances are operated in towns with a population between 5000 and 30 000 inhabitants, which implies a longer response time. We hope to improve the call-to-shock times once all the AEDs have been distributed in these rural areas to deal with patients suffering cardiac arrest in small villages. This issue will be further analysed in the near future.

The advantage of having collected all cases of SCD with BLS/AEDs or with advanced life support in medical ambulances, is that it allows us to have overall idea of the efficacy of the Galician emergency system. The causes of low survival in the emergency system are [2]:

. long response intervals,
. late activation of the Emergency Service,
. arrest not witnessed,
. incidence of bystander BLS,
. long defibrillation time taken by the health team.

In our case the two main problems detected were late activation of the Emergency Service and the low incidence of BLS by a witness. These are poor when compared with more developed Emergency Systems.

Table 3
Comparison of bystander CPR and time intervals

Emergency services				% BLS bystander	Time Interval OHCA-shock	Time Interval call-shock
PEHF-061 AED BLS-A				21.6	15?	12?
PEHF-061 ALS-A				33.7	9? (m 14.4)	
	Setting	CPR performed by	Authors			
Iowa	R	T	Stults (1984) [10]	20	6?	
Minnesota	R	T	Bachman (1986) [11]	36.7		
Seattle	U	F	Weaver (1988) [12]	36		4
Ontario	U	T	Stiell (1999) [13]	45		B 8 (90%)
Charlotte (N CAR)	U	F	Sweeney (1998) [14]	45		BLS 4? ALS 11?
Amsterdam	U	PM	Waalewijn (1998) [15]	54	9?	
Memphis	U	F PM	Kellerman (1993) [16]	12		3? (B) 6? (PM)
Rochester	U	F PM	White (1996) [17]	43		
Allegheny	SU	P PM	Mosesso (1998) [18]	28		
5 REG. Europe	U		Herlitz (1999) [19]	27 67	7 11?	
Hong Kong	U	T	Lui (1999) [20]	8.9	23?	6? 42ƒ
London	U	P	Ross (2001) [21]			9
Sweden			Holmberg (1998) [22]	32	13?	
Wisconsin	R SU	T	Olson (1989) [23]	49	11.5 (5? superv)	7?

R, rural; T, technicians; U, urban; F, fire department; SU, suburban; P, police officers; PM, paramedics.

These two problems can be overcome by training the population.

For the future, we make the following proposals:

. To involve other first responders such as Civil Protection Volunteers and the City Police Force, by training in BLS/AED.
. Teaching BLS to the population in general. There is a Collaboration Project between the 061 of Galicia and the Conselleŕia de Educacio´ n to teach BLS in High Schools.
. To provide dispatcher assisted BLS by telephone. In some centres [24] there is a protocol of telephone instructions so that witnesses of a cardiac arrest can assist the patient, while the emergency units are on their way. The Dispatch Centre of the 061 is already carrying out BLS assisted by telephone.

Table 4
Comparison initial rhythms survival

Emergency services	% VF	% Discharged alive VF patients	% Discharged alive all rhythms
PEHF-061 AED BLS-A	26		2
PEHF-061 ALS-A	31	16	3.3 12.3
Iowa	58	19	
Minnesota	66	7.4	2.9
Seattle	87	30	
Ontario	37.5	11.9	5.2
Charlotte (N CAR)	57		1.6
Amsterdam	62		7.9
Memphis	49	9.8	6.3
Rochester	53	49	
Allegheny	44	26 (P) 9 (PM)	
5 Reg. Europe	46 61	27 55	15 23
Hong Kong	22	6	1.6
London	52	15	
Sweden	61	9.5	5
Wisconsin	54	11	6.4

5. Conclusions

The programme followed for the introduction of AEDs in Galicia was adapted to the socio-demographic characteristics of the population and an out-of-hospital emergency assistance model developed, executed and controlled by PEHF-061. The overall results of our first 10 months with the semiautomatic defibrillation programme were as expected. In general, they are comparable to those published. Ways of reducing the interval from the time of collapse to defibrillation must be introduced by training the population and through the extension of semiautomatic defibrillation to other first responders.

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