Out-of-Hospital Cardiac Arrest in Bariloche: Incidence, Distribution and Context. Evaluation of the Potential Usefulness of an Automated External Defibrillator Program

Paro cardíaco extrahospitalario en Bariloche: incidencia, distribución y contexto. Evaluación de la potencial utilidad de un programa de desfibriladores externos automáticos

MARIANO TREVISAN¹, JORGE L. BOCIAN¹, MARIO CAMINOS², MARÍA EMILIA SAAVEDRA³, MARÍA E. ZGAIB⁴, ANTONIO BAZÁN⁵, DANIEL J. ABRIATA², MATÍAS E. CALANDRELLI¹

ABSTRACT

Background: The incidence and distribution of potentially resuscitable out-of-hospital cardiac arrests in a community should be determined before implementing an automated external defibrillator program in order to anticipate its effectiveness.

Objectives: The aims of this study were: 1) to determine the annual incidence, distribution and context of out-of-hospital cardiac arrest in the city of Bariloche; and 2) according to the information obtained, to evaluate the potential usefulness of an automated external defibrillator program in the city, in public locations or in the patients' homes.

Methods: A one-year prospective registry of out-of-hospital cardiac arrests was carried out in the setting of the REGIBAR study, using The Registry Office as source of information. The cases of myocardial infractions hospitalized and presenting as cardiac arrest prior to arrival at hospital were also analyzed. Verbal autopsies were performed to establish if the death was due to cardiovascular disease and to determine its context. Out-of-hospital cardiac arrests were classified as those occurring within the patient's home or in public locations. The presence of cohabitants and witnesses of cardiac arrests occurring at home and the history of myocardial infraction/heart failure were recorded.

Results: During the study period, 61 out-of-hospital cardiac arrests occurred (age: 78.3; range: 47-100), 40% were women and 52% were \geq 80 years of age. Incidence: 53/100,000 person-years. None of the cases of cardiac arrest prior to hospital arrival undergoing resuscitation reached the hospital alive. Prior myocardial infarction/heart failure was present in 11.5% (7/61) of the cases. Sixty cardiac arrests occurred at home and one took place in a public space. The emergency medical service system was contacted in 20% of the cases and 10% underwent cardiopulmonary resuscitation. Seventy-five percent (45/60) of the subjects who experienced cardiac arrest at home were not living alone, but only in 12% (7/60) of cases cohabitants witnessed their death.

Conclusions: The incidence of out-of-hospital cardiac arrest in Bariloche was 53/100,000 person-years. Only one case occurred in a public space. An emergency medical service attended 1 out of 5 cases and half of these cases underwent cardiopulmonary resuscitation. None of the cases of out-of-hospital cardiac arrest arrived alive at hospital. Only 1 out of 10 cardiovascular deaths at home was witnessed. The implementation of an automated external defibrillator program does not represent an advisable strategy in Bariloche.

Key words: Out-of-hospital cardiac arrest - Epidemiology - Automated external defibrillator

RESUMEN

Introducción: A los efectos de anticipar la eficacia de la implementación de un programa de desfibriladores automáticos en una comunidad, resulta indispensable determinar la incidencia y la distribución de los paros cardíacos extrahospitalarios potencialmente reanimables en esa comunidad.

Objetivos: 1) Determinar la incidencia anual, distribución y contexto del paro cardíaco extrahospitalario en la ciudad de Bariloche; 2) de acuerdo con los datos obtenidos, evaluar la potencial utilidad de un programa de implementación de desfibriladores automáticos en la ciudad, tanto para espacios públicos como para casos domiciliarios.

Material y métodos: En el marco del estudio REGIBAR, se realizó un registro prospectivo de paros cardíacos extrahospitalarios durante un año y se utilizó como fuente el Registro Civil. Además, se analizaron los casos de infarto que fueron internados y se hubieran presentado como paro cardíaco prehospitalario. Para determinar si la muerte había sido de causa cardiovascular y conocer su contexto se realizaron autopsias verbales. Según el lugar del evento, los paros cardíacos extrahospitalarios se dividieron en domiciliarios y en espacios públicos. Se registró la presencia de convivientes y de testigos del evento en los casos de paros cardíacos domiciliarios, así como el antecedente de infarto/insuficiencia cardíaca previos.

REV ARGENT CARDIOL 2018;86:329-335. http://dx.doi.org/10.7775/rac.v86.i5.12640

Received: 04/19/2018 - Accepted: 07/26/2018

Address for reprints: Mariano Trevisan - Sanatorio San Carlos. Servicio de Cardiología - San Carlos de Bariloche, Río Negro. e-mail: mtrevisan@yahoo.com

- ² Hospital Privado Regional, Bariloche
- ³ Hospital Ramón Carrillo
- ⁴ SAC District, Bariloche
- ⁵ Sanatorio del Sol, Bariloche

¹ Sanatorio San Carlos

Resultados: Durante el período estudiado, se registraron 61 paros cardíacos extrahospitalarios (edad 78,3; rango: 47-100). El 40% eran mujeres y el 52% tenía \geq 80 años. Incidencia: 53/100 000 personas-año. No se encontraron casos de paro cardíaco prehospitalario reanimados que hubieran llegado vivos a un centro de salud. Un 11,5% (7/61) presentaba infarto/insuficiencia cardíaca previos. Hubo 60 paros cardíacos domiciliarios y un caso de paro cardíaco en espacio público. Se dio aviso al servicio de emergencias en el 20% de los casos, y 10% recibió maniobras de reanimación. De los paros cardíacos domiciliarios, el 75% (45/60) tenía convivientes, pero solo en el 12% de las veces (7/60) estos presenciaron el fallecimiento.

Conclusiones: La incidencia del paro cardíaco extrahospitalario en Bariloche fue de 53/100 000 personas-año. Solo un caso ocurrió en espacio público. En 1 de cada 5 casos, acudió un servicio de emergencias, y la mitad de estos recibió maniobras de reanimación. No hubo casos que lograran llegar a un centro de salud luego del paro cardíaco extrahospitalario. De las muertes cardiovasculares domiciliarias, solamente 1 de cada 10 fueron presenciadas. La implementación de un programa de desfibriladores externos automáticos no representaría una alternativa recomendable en Bariloche.

Palabras Clave: Paro cardíaco extrahospitalario - Epidemiología - Desfibriladores

Abbreviations

CVM	Cardiovascular death	AED	Automated external defibrillator
OHCA	Out-of-hospital cardiac arrest	AMI	Acute myocardial infarction
PHCA	Prehospital cardiac arrest	HF	Heart failure
OHCVD	Out-of-hospital cardiovascular death	cv	Cardiovascular
AHCA	At-home cardiac arrest		

INTRODUCTION

Cardiovascular (CV) diseases are the leading cause of death in our country. In Argentina, according to data provided by the National Ministry of Health based on death certificates, 28.3% of deaths were due to cardiac causes in 2014. (1) It has been estimated that approximately 2/3 of all deaths occur outside a hospital setting. (2) The chances of survival for patients with out-of-hospital cardiac arrest (OHCA) are still very low worldwide; however, access to defibrillation at the time of cardiac arrest can restore normal heart rhythm and change the outcome. (3, 4)

The availability of automated external defibrillators (AED) located in public locations (similar to fire extinguishers) or in the homes of individuals at increased risk for cardiac arrest, could contribute to reduce mortality from this disease. (5, 6) However, and based on the rational use of health resources, the incidence of OHCA successfully resuscitated in public settings or at home should be known for a more efficient distribution of AED and to design the best health care prevention strategy. (7) It is important to distinguish between highly crowded locations (airports, shopping malls or sports venues) and less crowded locations (public thoroughfares or outdoor spaces) in order to optimize the distribution of AED in public spaces, depending on the likelihood that an event will occur in that area that would justify the availability of an AED. (8)

A large study conducted in Canada and USA, covering a population of more than 21 million inhabitants, found a marked difference between regions in both the incidence and outcome of OHCA. (9) Dissimilar incidence rates have also been obtained in different cities in Europe and Asia. (10) In our country, the incidence of sudden death in 20 cities was evaluated in a registry during 2 months based on death certificates and verbal autopsies to determine the causes of death. The authors remarked the difficulty of extrapolating the results due to the great heterogeneity in the inclusion criteria, selected populations and different geographical areas. (11) This demonstrates the need for local data for our region. San Carlos de Bariloche is a city with 112,887 inhabitants, (12) located in the west of Rio Negro. The communal land has a surface area of 24,571 hectares, higher than that of the Autonomous City of Buenos Aires. It has an east-west length of more than 30 km and a variable north-south width of no more than 8 km. Within the communal land, densely populated areas currently coexist with others that are not occupied for different reasons: the broken slopes of the mountain front, the environmental buffer zones bordering the national park and public lands, among others. (13) These particular urbanization characteristics make it difficult to extrapolate data related with the incidence and distribution of OHCA in other urban centers.

A possible benefit of the use of home AED has been suggested for individuals at high risk of OHCA. (14) Although a large study did not demonstrate benefit with the use of home AED in patients with prior infarction, the authors recognize that annual mortality was much lower than expected in the control group, mostly due to the fact that patients at higher risk had an implantable defibrillator (ICD) and had been previously excluded from the study. (15) Aside from the context of clinical trials, the rate of ICD use is low, with marked regional differences. (16) Therefore, the incidence of at-home cardiac arrest (AHCA) and the potential usefulness of home AED in our setting should be investigated. It is important to know the context in which AHCA occur (previous cardiovascular risk, circumstances of the event) and the presence or absence of cohabitants and witnesses of the arrhythmic event that may activate the device in due time and form to anticipate the real impact of this policy. (17)

In order to obtain specific information for the local setting, and within the framework of the REGIBAR study, (18) we conducted a prospective registry of OHCA in the city of San Carlos de Bariloche.

The objectives of this study were

- 1) to determine the annual incidence, distribution and context of OHCA in the city of Bariloche.
- 2) According to the information obtained, to evaluate the potential usefulness of an AED program in the city, both in public locations as in the patients' homes.

METHODS

Study design and patient population Data collection

A prospective registry was made of all the consecutive OHCA that took place from 0 a.m. on June 1, 2014, to 11:59 p.m. on May 31, 2015 (365 days). All the persons living in the city of Bariloche over the past 6 months were included in the registry. The information was retrieved from two sources of the REGIBAR study (Figure 1):

Source 1. *Registry Office:* All the death records during the study period were reviewed. Those who died in hos-

pital settings with diagnosis of acute myocardial infarction (AMI) were excluded (as they were part of source 2). Those who died in a hospital setting or out of hospital without a clear non-cardiac cause as trauma, suicide, neoplasms, bleeding, sepsis or stroke, were also excluded from the study. In this way, the registry included all the subjects with an out-of-hospital death due to a potential cardiovascular cause on the one hand, and all the subjects who had died in hospital without a diagnosis of AMI and with possible cardiac arrest before arrival at hospital (prehospital cardiac arrest -PHCA) according to the death certificate. A verbal autopsy was performed in both groups to determine the cause of death. Briefly, a verbal autopsy consists of a printed survey where the personal medical history and previous symptoms are documented to guide the cause of death and classify the event, following the PRISMA study model. (19) A registered nurse with experience in epidemiological studies was trained to conduct the verbal autopsies, interviewing physicians who signed the death certificates, witnesses, relatives, general practitioners and attending cardiologists.

Source 2. *Medical records during hospitalization:* Hospitalized patients with diagnosis of fatal or non-fatal AMI, as defined in a previous publication (19) were prospectively included. The cases presenting as PHCA were also included.

Definitions

Out-of-hospital cardiovascular death (OHCVD): Out of health facility deaths probably due to a CV cause. prehospital cardiac arrest (PHCA): All the patients presenting to a health care facility with cardiac arrest undergoing resus-



IH: In-hospital; OH: Out-of-hospital; VA: Verbal autopsy; DC: Death certificate; AMI: Acute myocardial infarction; CV: Cardiovascular; SD: Sudden death; OHCVD: Out-of-hospital cardiovascular death; PHCA: prehospital cardiac arrestl; OHCA: Out-of-hospital cardiac arrest.

Fig. 1. OHCA: Selection of the population included in the analysis.

citation. Out-of-hospital cardiac arrest (OHCA): Cardiac arrest that occurs outside a health facility (OHCVD + PHCA). Two sites of OHCA were identified: public locations and patients home. Public locations with *high predicted incidence of OHCA* were defined as those with 0.03 events per site (1 event in 30 similar sites/year). (8) These public spaces are: airports, bus terminals, shopping malls, sports venues, clubs, industrial sites and casinos. The rest of the public spaces were considered of low predicted incidence of OHCA. At-home cardiac arrest (AHCA) was every OHCA that occurred at home. The person who lived in the same home with the patient at the moment of AHCA was defined as co-habitant. The cohabitant could have witnessed the event, or not. The witness was the cohabitant who was present at the moment of AHCA and could have taken action.

History of AMI or heart failure (HF) was considered a high pretest for CV disease. The intervention of the public or private emergency medical services in OHCA was classified in OHCA evaluated by an *emergency medical service* (when the emergency medical service attended the site of cardiac arrest) and OHCA assisted by an *emergency medical service* (when cardiopulmonary resuscitation was performed).

Statistical analysis

Data were prospectively incorporated into specially designed databases and presented as percentages, mean and 95% confidence intervals.

To compare with other registries, the crude incidence of OHCA per 100,000 person-years, standardized by the direct method, was calculated using the weighted values of the MONICA Data Center for the age range of 35 to 64 years: 35-44 (1/11), 45-54 (3/11) and 55-64 (7/11). (20)

Ethical considerations

The protocol was approved by the Ethics Committee of Hospital Zonal Bariloche "Ramón Carrillo" and was conducted following the recommendations of the Declaration of Helsinki. (21) Cohabitants, family members or treating physicians gave their written consent before being interviewed for a verbal autopsy.

The study was declared of municipal interest by the Municipality of San Carlos de Bariloche (Ordinance 2071-CM-10, November 12, 2013).

RESULTS

According to the Registry Office (Source 1), 193 deaths occurred out of hospital: 123 were due to non-cardiac causes (traumatic death, suicide, cancer, bleeding, sepsis or stroke) as reported on the death certificate. The remaining 70 deaths underwent verbal autopsy and 61 were classified as OHCVD (Figure 1). Among the latter, 16 were possible fatal AMI and 45 were unclassified deaths (included according to the MONICA project criteria).

During the study period, among the 80 patients

hospitalized with diagnosis of AMI (8 deceased and 72 discharged), none of them presented with PHCA . On the other hand, among the patients who died during hospitalization due to other causes (not AMI), but who could potentially have presented PHCA (6/305 patients), none of the cases were confirmed by verbal autopsy.

The crude incidence of OHCA was 53 cases per 100,000 person-years and the age-standardized incidence rate (35-64 years) was 63.4 cases per 100,000 person-years. Mean population age was 78.3 years (range: 47-100) and there were no OHCA in persons <18 years. Forty percent of cases were women and 53% were \geq 80 years. Prior AMI/HF was present in 11.5% (7/61) of the cases (Table 1).

Sixty cardiac arrests occurred at home and 1 in a public thoroughfare, a space considered of low incidence for OHCA. In 12 cases (20%) OHCA was evaluated by an emergency medical service; 6 of these 12 cases (10%) received CPR (assisted OHCA), including the event in the public thoroughfare, while death was confirmed in the other 6 cases. None of the cases survived until arrival at the health care center.

Verbal autopsy revealed that 55/60 (92%) AHCA occurred while the patient was in bed, either sleeping of after the patient had lied down due to unspecific discomfort (Figure 2). In 75% of the cases (45/60) other persons were at home at the moment of death and 12% (7/60) witnessed the event and could potentially have acted (Figure 3).

DISCUSSION

This registry demonstrates that the incidence of OHCA in the city of Bariloche was 53/100,000 personyears. This number is somewhat lower than the average observed in the sub-analysis of the PRISMA study (73/100,000 person-years) (11) In England the incidence was similar (53/100,000 person-years) in a significantly larger population. (22) However, our findings show a lower incidence of OHCA than in the ROC study (United States and Canada) where, in any case, there was great variability in the incidence between the cities surveyed (71.8 to 159/100,000 person-years). (9) Similarly, in a systematic review that included 67 studies analyzing the incidence of OHCA in Europe, North America, Asia and Australia, Berdowski et al. observed up to tenfold variability among the regions evaluated (from 20.9 to 186/100 000 person-years). (23) This data dispersion is probably due to multiple factors (differences in case definition and source, demographic characteristics and baseline population

n	Total 61	Men 36	Women 25
Age (x̄, CI)	77 (69-87)	74.7 (68.5-63)	83.4 (79-88)
High pretest for cardiovascular death	7 (11.5%;	5 (14.3%;	2 (7.7%;
(candidate for AED (n, % and CI)	CI 4.7%-22.2%)	CI 4.8%-30.2%)	CI 1%-25.1%)

Table 1. Demographic char-
acteristics of individuals with
out-of-hospital cardiac arrest

risk) and reinforces the need for obtaining local information.

It should be noted that this work recorded all OHCA and not only those who were assisted by an emergency medical service. This type of populationbased survey provides additional information of the events that did not receive medical attention, helps to know their context, and may serve as a starting point for designing strategies to facilitate access to the health system and improve survival.

The UKHAS (United Kingdom Heart Attack Study) study, which prospectively assessed a population of 954,000 individuals, found that 8 out of 10 OHCA occurred at home, and were witnessed in less than half of the cases. (24) The HAT study, which evaluated the efficacy of a home AED program in patients with prior coronary heart disease found that out of 160 sudden death events, 117 occurred at home and 9 in public spaces, (15) findings that are similar to those of our registry.

On the other hand, it has been suggested that the distribution of AED in public spaces should be guided by the specific incidence of OHCA in each type of location, and that AED availability would only be justified in areas with high expected incidence of events (such as airports, shopping malls, sports venues or public transport terminals). Each community is also encouraged to identify those sites with high incidence of OHCA in order to rationally plan the distribution of AED. (25, 26) Examining the circumstances of the only death occurring in a public thoroughfare in our study, it took place in a space considered of low incidence of OHCA.

In the case of AHCA, despite 3 out of 4 individuals did not live alone, only 1 out of 10 events was witnessed. Verbal autopsy revealed that AHCA occurred without alarm symptoms in most cases (92%; 55/60). In the same sense, the HAT study reported that only 55 of 117 events at home (49.6%) were witnessed. These data suggest that the availability of an AED at home, even with the presence of cohabitants at the time of the event, does not imply that this device will be used in time to prevent the fatal outcome.

In our registry, the prevalence of known cardiovascular disease that could predict the event was extremely low, making it difficult to identify a population at risk that could obtain greater benefit from the availability of AED at home.





Fig. 3. Cohabitants and witnesses of at home cardiac arrest.

This study also demonstrates the feasibility of using verbal autopsy in a population and of obtaining reliable information when added to quantitative records. (27) This may be repeated in this population or in others in the future, and thus compare the data obtained with the same instrument.

Limitations

This study has several limitations. Firstly, it would have been useful to extend the registry for a longer period in order to define more clearly the geographical distribution of OHCA, given the low incidence of events during the study period. However, the low total incidence is a relevant fact in itself, as it may be used to delineate health policies with an efficient management of the resources available,

Secondly, although we employed the methodology for classifying events used in the MONICA project, (28) the fact that unclassified deaths were considered OHCA may imply an inclusion bias as the cause of death was not corroborated by autopsy. In our registry, we favored sensitivity over specificity, so as not to exclude any potential candidate to undergo defibrillation. Thus, the efficacy of an out-of-hospital AED program could hardly have been underestimated using this screening method.

Finally, the number of events could have been underreported due to the nature of the design. By definition, the registry excluded cases of OHCA (in public spaces or at home) that were assisted by an emergency medical service, transported to a health care facility, finally survived the event (not detected by the Registry Office records) and did not have a diagnosis of AMI (other cardiomyopathies or channelopathies not recorded during hospitalization). This phenomenon could also explain the fact that the age of the deceased was high, as there is an inverse association between age and the probability of surviving cardiac arrest. (29, 30)

CONCLUSIONS

The incidence of OHCA in the city of Bariloche was 53/100,000 person-years. Only one case occurred in a public space. The rest of deaths occurred at home, mostly with no witnesses and with high prevalence of elderly population. The rate of emergency medical system activation was low and no cases arrived alive at hospital. In light of the results obtained, it is not possible to state that an AED program distributed in public spaces or homes in Bariloche would represent a potentially effective strategy.

From the perspective of optimizing the use of resources in public health, our findings reinforce the need for local registries to develop strategies for rapid access to defibrillation in out-of-hospital settings.

Conflicts of interest

None declared.

(See authors' conflicts of interest forms on the website/ Supplementary material) Research team:

Investigators (by center):

Hospital Zonal Bariloche: María Emilia Saavedra (coordinator), Pedro Zanardo, Tania Viaene.

- Hospital Privado Regional: Mario Caminos (coordinator); Daniel Abriata.
- Sanatorio del Sol: Antonio Bazán, Victoria Capurro, Ernesto Terán.

Sanatorio San Carlos: Jorge Bocian (coordinator), Matías Calandrelli, Mariano TrevisAn.

Ambulatory cases: Marisa Parola, María Elisa Zgaib. Clinical events committee: Jorge Grilli, Daniel Abriata. Verbal autopsy: Ayelén Mansilla.

Acknowledgments

We are grateful to Dr. Javier Mariani for his critical revision of the manuscript.

REFERENCES

1. Estadísticas vitales. Información básica, año 2014. Serie 5 - Número 58. Ministerio de Salud; Presidencia de la Nación. In: http://deis.msal.gov.ar/wp-content/uploads/2016/01/Serie5Nro58.pdf

2. Eisenberg MS, MengertTJ. Cardiac resuscitation. N Engl J Med 2001;344:1304-13. http://doi.org/dgb9qz

3. Caffrey SL, Willoughby PJ, Pepe PE, Becker LB. Public use of automated external defibrillators. N Engl J Med 2002;347:1242-7. http://doi.org/bjgc8p

 Ong MEH, Perkins GD, Cariou A. Out-of-hospital cardiac arrest: prehospital management. Lancet 2018; 391: 980-8. http://doi.org/ gc736r

5. Nichol G, Hallstrom AP, Kerber R, Moss AJ, Ornato JP, Palmer D, et al. American Heart Association report on the second public access defibrillation conference, April 17-19, 1997. Circulation 1998;97:1309-14. http://doi.org/csqw

6. Pollack RA, Brown SP, Rea T, Aufderheide T, Barbic D, Buick JE, et al. Impact of Bystander Automated External Defibrillator Use on Survival and Functional Outcomes in Shockable Observed Public Cardiac Arrests. Circulation 2018;137:2104-13. http://doi.org/gdsr29
7. Priori SG, Bossaert LL, Chamberlain DA, Napolitano C, Arntz HR, Koster RW, et al. ESC-ERC recommendations for the use of automated external defibrillators (AEDs) in Europe. Eur Heart J 2004;25:437-45. http://doi.org/cdzgn4

8. Becker L, Eisenberg M, Fahrenbruch C, Cobb L. Public locations of cardiac arrest: implications for public access defibrillation. Circulation 1998;97:2106-9. http://doi.org/csqx

9. Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, et al. Regional variation in out-of-hospital cardiac arrest incidence and outcome. JAMA 2008;300:1423-31. http://doi.org/d2927k
10. Berdowski J, Berg RA, Tijssen JG, Koster RW Global incidences of out-of-hospital cardiac arrest and survival rates: systematic review of 67 prospective studies. Resuscitation 2013; 81:1479-87. http://doi.org/cbgxfz

11. Muratore C, Belziti C, Gant López J, Di Toro D, Mulassi A, Corte M, y cols. Incidencia y variables asociadas con la muerte súbita en una población general. Subanálisis del estudio PRISMA Rev Argent Cardiol 2006;74:441-6.

12. http://www.rionegro.gov.ar/index.php?contID=15965 (cuadro P01)

13. Sánchez D, Sassone S, Matossian B. Departamento de Investigaciones Geográficas (DIGEO-IMHICIHU-CONICET) Barrios y áreas sociales de San Carlos de Bariloche: Análisis geográfico de una ciudad fragmentada http://www.redaepa.org.ar/jornadas/ixjornadas/ resumenes/Se16--Patagonia_Herrero/ponencias/Sanchez_Sassone_ Matossian.pdf

14. Garg A. Primary prevention of sudden cardiac death – Challenge the guidelines. Indian Heart J 2015;67:203-6. http://doi.org/csqz

15. Bardy GH, Lee KL, Mark DB, Poole JE, Toff WD, Tonkin AM, et al. Home use of automated external defibrillators for sudden cardiac arrest. N Engl J Med 2008;358:1793-804. http://doi.org/fkgwqz

16. Parkash R, Wightman H, Miles G, Sapp JL, Gardner M, Gray C,

et al. Primary prevention of sudden cardiac death with device therapy in urban and rural populations. Can J Cardiol 2017;33:437-42. http://doi.org/f97k6p

 $17.\,\rm Norris\,RM.$ Circumstances of out of hospital cardiac arrest in patients with ischaemic heart disease. Heart 2005;91:1537-40. http://doi.org/fjdmgd

18. Calandrelli M, Caminos M, Bocian JL, Saavedra ME, Zgaib, ME Bazan A, y cols. Incidencia anual y letalidad del infarto agudo de miocardio en la ciudad de Bariloche. Estudio REGIBAR. Rev Argent Cardiol 2017;85:428-34.

19. Muratore C, Belziti C, Di Toro D, Gant López J, Mulassi A, Barrios A, y cols. Precisión del certificado de defunción comparado con la autopsia verbal. Estudio PRISMA. Rev Argent Cardiol 2006;74: 211-6.

20. WHO MONICA Project. MONICA Manual. Part IV: Event registration. Section 1: Coronary event registration data component. (March 1999). Available from: URL: http://www.ktl.fi/publications/ monica/manual/part4/iv-1.html, URN:NBN: fi-fe19981154.

21. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA 2013; 310:2191-4. http://doi.org/3cp

22. Hawkes C, Bootha S, Chen L, Brace-McDonnell SJ, Whittington A, Mapstone J, et al. Epidemiology and outcomes from out-of-hospital cardiac arrests in England. Resuscitation 2017;110:133-40. http://doi.org/f9vqz9

23. Berdowski J, Berg RA, Tijssen JG, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: systematic review

of 67 prospective studies. Resuscitation 2010;81:1479-87. http://doi.org/cbgxfz

24. Norris RM. Circumstances of out of hospital cardiac arrest in patients with ischaemic heart disease. Heart 2005;91:1537-40. http:// doi.org/fjdmgd

25. Becker L, Eisenberg M, Fahrenbruch C, Cobb L. Public locations of cardiac arrest: implications for public access defibrillation. Circulation 1998;97:2106-9. http://doi.org/csqx

26. Ringh M, Hollenberg J, Palsgaard-Moeller T, Svensson L, Rosenqvist M, Lippert FK. The challenges and possibilities of public access defibrillation. J Intern Med 2018;283:238-56. http://doi.org/csq2

27. Cárdenas R. El uso de la autopsia verbal en el análisis de la salud. 2000. Estudios demográficos y urbanos.colmex.mx/index.php/edu/article/download/1090/1083

28. Tunstall-Pedoe H, Kuulasmaa K, Mähönen M, Tolonen H, Ruokokoski E, Amouyel P, et al. Contribution of trends in survival and coronary event rates to changes in coronary heart disease mortality: 10-year results from 37 WHO MONICA Project populations. Lancet 1999;353:1547-57. http://doi.org/b46n63

29. Wissenberg M, Folke F, Hansen CM, Lippert FK, Kragholm K, Risgaard B, et al. Survival After Out-of-Hospital Cardiac Arrest in Relation to Age and Early Identification of Patients With Minimal Chance of Long-Term Survival. Circulation 2015;131:1536-45. http://doi.org/csq3

30. Myat, Aung & Song, Kyoung-Jun & Rea, Thomas. Out-of-hospital cardiac arrest: current concepts. Lancet 2018;391: 970-9. http://doi.org/gc76gb