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Training in Cardiopulmonary Resuscitation and in-Hospital Cardiopulmonary Arrest Treated in A Second-Level Hospital in Spain

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ABSTRACT

Introduction: Cardiopulmonary arrest is a leading cause of premature death; it is unpredictable and potentially reversible. When it occurs in a hospital, the patient has a greater chance of survival. Bidasoa Hospital has a cardiopulmonary resuscitation training group and a structured response system for in-hospital cardiac arrest.

Objective: To evaluate the training program and the epidemiological characteristics of in-hospital cardiorespiratory arrests treated since 2016.

Method: Observational, retrospective and descriptive study. Registration records for CPR courses held between 2020 and 2025 were reviewed, analyzing the type of training received, participating professional categories, course repetition, and expressed satisfaction. In-hospital cardiac arrests recorded between January 2016 and December 2025, coded with diagnoses of cardiac arrest, were also analyzed. For each episode, sociodemographic and episode variables were collected following the international Utstein model. In the analysis of the results, p-values <0.05 were considered statistically significant.

Results: A low survival rate was observed (20% of resuscitated cardiac arrests), lower than that described in the literature. This is despite having an effective and widely accepted ongoing training program and an organized response system.

Conclusions: The study makes it possible to identify areas for improvement, such as the need to establish a mandatory and standardized record of all cardiorespiratory arrests attended, following the Utstein model; to insist on correct coding; and to reinforce periodic refresher training.

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Introduction

Cardiorespiratory Arrest (CA) is the most serious medical emergency and one of the main causes of premature mortality in developed countries [1,2]. In-Hospital Cardiac Arrest (IHCA) has a higher chance of survival thanks to a faster response, with specialized professionals and equipment [3-7]. Recognizing the event and initiating early cardiopulmonary resuscitation (CPR) are essential.

The incidence of IHCA ranges from one to five episodes per thousand hospital admissions [2,6,9]. The Return of Spontaneous Circulation (ROSC) rate has improved from the 15% described at the beginning of the 21st century to approximately 50%, with a final survival rate between 23% and 43% [6,7,10-12]. Continuing CPR training is a priority strategy in healthcare organizations [13-15].

Bidasoa Hospital is a secondary-level regional hospital with 96 inpatient beds. For 20 years, it has had a multidisciplinary team dedicated to training in basic (BCPR) and advanced (ACPR) CPR,

officially recognized in 2020, which follows the guidelines of the European Resuscitation Council. BCPR training is aimed at all healthcare and non-healthcare staff with the goal of ensuring the early identification of cardiac arrest and the initiation of resuscitation maneuvers. ACPR training is intended for the professionals responsible for this care: Emergency department, Anesthesiology, and Internal Medicine. The training combines theoretical content available on the corporate intranet with in-person practical simulation in three- and six-hour workshops for groups of 12 and 18 students, respectively. Participation is voluntary, encouraged, and funded by the hospital.

The hospital also has a structured response system for IHCA, based on the telephone activation of specialized teams distributed across different care areas. All areas have crash carts equipped with defibrillators, medication, and advanced airway management equipment. In addition, there are automated external defibrillators to cover more remote areas [3-5].

Justification of the Study

A systematic evaluation of either the training program or the epidemiological characteristics of the IHCA attended had never been carried out, which prevented the impact of this investment and potential areas for improvement from being assessed.

Objective

To fill the information gap, we set out to analyze

- The training activities carried out and the level of satisfaction.
- The characteristics of patients treated by IHCA: the cause of admission, the initial rhythm, the location of the episode, and the reaction time, as well as the characteristics of the response provided: defibrillations, medication, airway management, and the results obtained in terms of Return of Spontaneous Circulation (ROSC) and survival.

Finally, the study aims to identify areas for improvement.

Materials and Methods

Training Section

Registration records for CPR courses held between 2020 (the group's official establishment date) and 2025 were reviewed, analyzing the type of training received, the participating professional categories, course repetition, and satisfaction expressed through Likert-type questionnaires (rating from 1 to 10) and open-ended questions.

Epidemiological Section

A retrospective, descriptive, observational study was designed based on case registries, analyzing all IHCA cases registered between January 2016 (when coding began at our center using the International Classification of Diseases (ICD-10) and December 2025.

The cases were identified by reviewing the ICD-10 codes related to CA diagnoses: cardiorespiratory arrest (I46.8 and I46.9), ventricular fibrillation (I49.0 and I49.01), ventricular tachycardia (I47.2), asystole (I46), and electromechanical dissociation (I85). The emergency department records coded as deaths (R99) were added. An individual review of the medical records confirmed that these were CA. Patients with do-not-resuscitate orders or expected deaths were excluded.

The extraction of epidemiological data was carried out by exploiting the information contained in the computer system, while the items related to the analysis of each case were extracted from each record.

For each episode, variables have been collected following the international Utstein model: age, sex, cause of admission, responsible service, place of CA, initial rhythm, witnessed nature of the event, first responder, response times, duration of CPR, use of defibrillation, medication administered, advanced airway management, use of capnography, ROSC and hospital survival.

Statistical Analysis

Categorical variables are presented as frequencies and percentages (n, %), and continuous variables as means. Comparisons of results were performed using the chi-square test for categorical variables and the student's t-test for continuous variables. A p-value <0.05 was considered statistically significant. Statistical analyses were performed using Python (version 3.5.1) in conjunction with the SciPy package (version 1.2.1).

Ethics

Work approved by the Gipuzkoa Research Ethics Committee. Code: ID-PCR-2025-01.

Work partially communicated at the 36th SEMES Congress, San Sebastián, Guipúzcoa, Spain in June 2026.

Results

Training Section

33 BCPR courses and six ACPR courses have been taught.

A total of 530 professionals has been trained: 432 in BCPR, representing virtually all professional categories, hospital units, and medical specialties (Figure 1); and 99 in ACPR.

The recycling rate has been 11%.

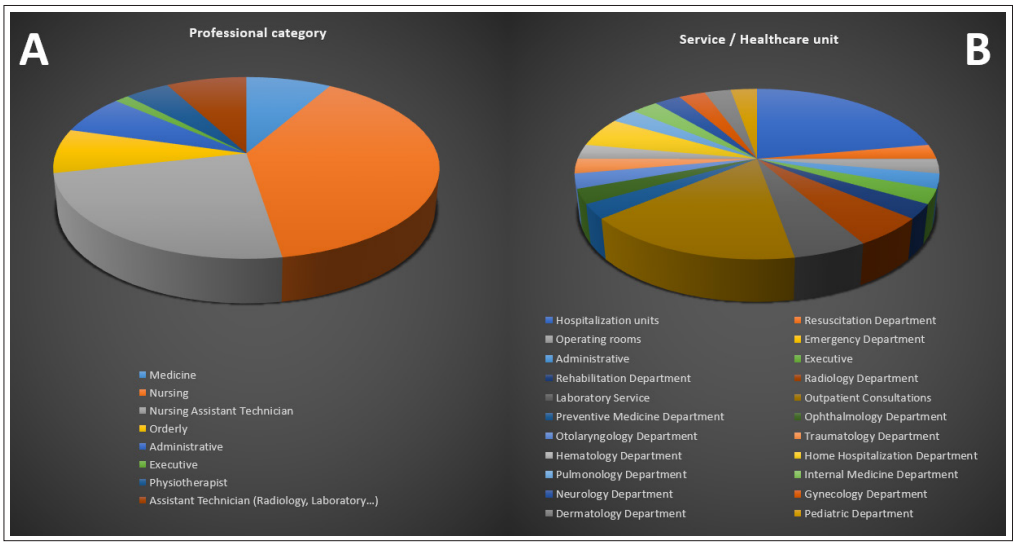

Figure 1: Distribution of student-professionals signed in BCPR. Distribution according to their professional category (A), and according to the hospitalization unit, outpatient service or medical specialties to which they belong (B).

Satisfaction was above 8 in all evaluated items for 92% of BCPR students and 97% of ACPR students. Professionals found the practicality of the simulations with real-life situations particularly useful. Negative points highlighted: equipment in need of replacement; inadequate spaces; high number of students per workshop; and the need for more frequent updates.

Epidemiological Section

54 IHCA were detected: CPR was performed in 35, with return of spontaneous circulation (ROSC) in 11 (31.5%) and final survival in 7 (20%). 95% in the emergency department, and 59% while the patient was monitored, with no statistically significant (n.s.s.) difference between resuscitated and non-resuscitated patients.

The mean age was 75.22 years (66.5% male), with n.s.s. difference detected between those patients in whom CPR was performed and those in whom it was not.

33% of IHCA were due to cardiac reasons, a significant differentiating factor between resuscitated and non-resuscitated cases: 42.8% vs. 15.7% (p = 0.026). The initial CA rhythm was also significantly different: shockable in 34.2% of resuscitated IHCA vs. 5.2% of non-resuscitated cases (p = 0.04).

Resuscitated CA were witnessed in over 90% of cases, mostly by the physician responsible for ACPR (p 0.0018). In these cases, CPR was initiated within the first minute after CA was detected, with a maximum delay of 5 minutes in one case. N.s.s. difference was found between those patients who achieved ROSC and those who did not. Other n.s.s. differences between patients resuscitated with ROSC and those who did not include: lower mean age; more frequent cardiac cause of CA; first CA rhythm being shockable; the same mean number of shocks; and the percentage of medication used: adrenaline was used in 81.8% of cases, with a mean of 4 doses, compared to 95%, with a mean of 3 doses; or orotracheal intubation. With the average duration of CPR being 25 minutes, this is shorter among CPRs with ROSC compared to those that were not achieved: 15 minutes versus 31 (p 0.026).

The reports barely mention whether or not capnography was used.

Once ROSC was achieved, 7 patients survived (63.6% of those who achieved ROSC).

Discussion

The study reveals that training reaches a large percentage of professionals and is well valued, but the progressive loss of skills would require further retraining [2-16].

The incidence of IHCA and the positive results obtained from the CPR provided are consistent with the literature (Table 1).

Variable	Number of cases/ 100 beds/year	Place (ED%)	Age	Sex (M%)	Cause (CARD%)	1st Rhythm (SHK%)	Time to Start CPR (minutes)	Duration of CPR (minutes)	ROSC%	Survival %
Case series	5,4	94,5	75,2	66,5	33	34,2	<1	25,3	31,5	20
Bibliography	2,7-12,58	24-52	63-75,7	50-67	39-64	15,9-35	0,8-2	7,8-25,8	50-55	23-43
Comparison	=	▲	=	=	=	=	=	=	▼	▼

Table 1: Comparative table of Demographic and epidemiological analysis data, response given, and results obtained between our series and those offered in the literature6-7,11,12,17-19. Place (ED%): percentage of total IHCA cases in which it occurs in the emergency department; Age: mean age of total IHCA cases; Sex (M%): percentage of males in total IHCA cases; Cause (CARD%):

percentage of cardiac cause among total IHCA cases; 1st Rhythm (SHK%): percentage of resuscitated IHCA cases in which the first detected heart rhythm was shockable; Time to Start of CPR (minutes): in resuscitated IHCA cases, time elapsed from the detection of cardiorespiratory arrest until the start of BCPR maneuvers; Duration of CPR (minutes): in resuscitated IHCA cases, duration of CPR either until ROSC or until death was certified; ROSC%: percentage of resuscitated IHCA cases in which return of spontaneous circulation is achieved; Survival%: percentage of resuscitated IHCA cases in which final survival is achieved. : Series value within the parameters of the literature; : Series value higher than that reported in the literature; : Series value lower than that reported in the literature

That almost all of the PCRIs registered come from the Emergency Department reflects a serious coding problem, while the fact that resuscitated INRs were witnessed by the responsible physician reflects a high degree of foresight.

The difference in CPR time between IHCA with ROSC and those in which it is not achieved is expected, because in the latter the possibilities of recovery are exhausted before stopping resuscitation.

ROSC and survival rates are lower than those reported by other hospitals. [6-7,11,12,17-19], although better than data from the beginning of the century [10]. The factors associated with a better prognosis are also consistent with those described in previous studies: younger age, cardiac cause of CA, shockable initial rhythm and speed in the start of resuscitation [12,16].

Despite an effective response system, we believe that our lower ROSC and survival rates compared to other centers may be due, to an unquantifiable degree, to the presence in the same building of the Advanced Life Support ambulance, which directly transports patients it treats outside the hospital with clinical conditions likely to lead to cardiac arrest to the tertiary center. Nevertheless, we have identified significant areas for improvement.

Limitations

The retrospective nature of the study and the small sample size may limit the significance of the differences and complicate the interpretation of the results.

The lack of a structured and mandatory registry makes it difficult to evaluate the quality of the procedures performed, their statistical analysis, and their comparison with other healthcare centers.

Conclusions

The study confirms the high mortality rate, also among IHCA, even with organized response systems in place.

Our experience demonstrates that a continuous training program for all staff enables a rapid and appropriate response.

Areas for improvement include: establishing a standardized and mandatory registry for all PCR tests (Utstein Model), emphasizing correct coding, and reinforcing regular refresher training.

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