## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.medin.2024.06.009.

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# In-hospital cardiac arrest simulation program in a cardiopulmonary critical care unit: A pilot experience

## Programa de simulación de paro cardíaco intrahospitalario en una unidad de cuidados críticos cardiopulmonares: una experiencia piloto

In-hospital cardiac arrest (IHCA) has an incidence of 1–6/1000 hospital admissions. Approximately one in four IHCA patients survive to discharge, but the neurological outcomes after the return of spontaneous circulation (ROSC) are often poor.[1] Outcomes are influenced by patient characteristics, the timing and location of the cardiac arrest, and the performance of the cardiac arrest team.[2] Improving the performance of the cardiac arrest team can significantly increase patient survival rates. Among educational methods, simulation is considered the most effective strategy for enhancing team communication, collaboration, teamwork, and leadership-fellowship relations.[3]

In Fondazione Toscana Gabriele Monasterio (FTGM), a public tertiary-level center specializing in cardiology, pulmonology, and heart surgery with locations in Pisa and Massa, Italy, we have initiated a pilot IHCA simulation program. This center includes a cath-lab hub for acute coronary syndrome, an adult and pediatric cardiac surgery center, and serves as a referral center for heart failure and primary pulmonary hypertension patients (123 beds; more than 5,000 hospital admissions per year). The aim of the program is to evaluate the intervention times of the intra-hospital emergency team and the Chest Compression Fraction (CCF) during simulated scenarios.

During six simulation sessions, each consisting of four clinical scenarios (see Supplementary Table) conducted in ward and outpatient settings, we recorded the following times (median with interquartile range):

- 8 [6–10] seconds from early recognition/evaluation to the activation of the emergency response;
- 30 [17–37] seconds from activation of the emergency response to the arrival of the defibrillator;
- 67 [46–78] seconds from activation of the emergency response to the arrival of the advanced medical response team.

In FTGM, nurses are often the first responders in cases of IHCA. Therefore, their competence during the initial

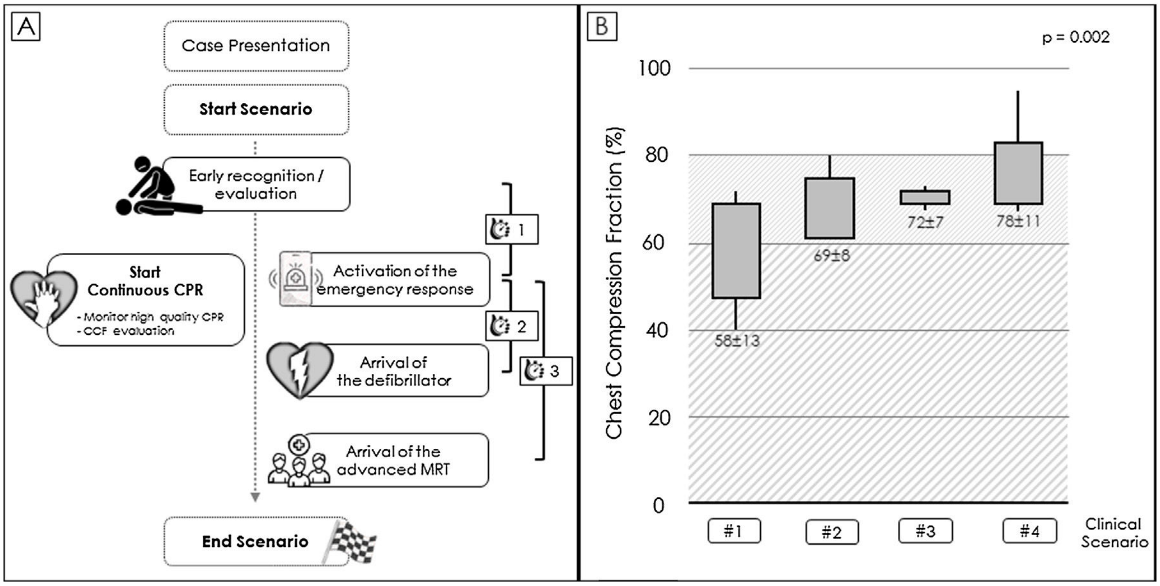


**Figure 1** *Panel A* – Flow-chart of intervention times measured during the simulation. *Panel B* - Time course of Chest Compression Fraction in the clinical scenario.
1 – Time from early recognition/evaluation to the activation of the emergency response; 2 – Time from activation of the emergency response to the arrival of the defibrillator; 3 - Time from activation of the emergency response to the arrival of the advanced medical response team; CCF - Chest Compression Fraction; CPR - cardiopulmonary resuscitation; MRT - medical response team.

assessment and performance of cardiopulmonary resuscitation (CPR) is crucial.[3] Adequate basic life support (BLS) by nurses, followed by the application of advanced cardiac life support (ACLS) upon the arrival of the advanced medical response team, is essential.[4]

The intervention times measured during the simulation (see Fig. 1 – Panel A) are consistent with those suggested by the guidelines[4] and aligned with other documented experiences.[2,3]

Additionally, the CCF progressively improved throughout the clinical scenarios (see Fig. 1 – Panel B). CCF refers to the amount of time during a cardiac arrest event that high-quality chest compressions are performed. To improve resuscitation outcomes, compression pauses for ventilation should be as short as possible, and achieving a CCF of at least 60% is recommended. Improving CCF to an 80% threshold has been shown to increase survival rates. These values were archived by the end of simulation sessions and conducting the periodic session (even 4–6 months) should help maintain these performance levels.

Currently, there are no international standards for the composition and task allocation of IHCA teams, resulting in varying team compositions among hospitals and countries.[2,3] The aim of this simulation program is to test our in-hospital emergency team. Moreover, following other successful experiences,[5] we have started a registry to monitor and evaluate the quality of care for patients with IHCA.

Maximizing the performance of quality CPR is critical not only to each individual patient case but also to the overall success of the organization, especially in a cardiopulmonary critical care unit. Pilot experience like this one can serve as best practice models for implementing life-saving programs to improve the survival rates from IHCA.

## Ethics approval and consent to participate

Not applicable.


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## Contributors

FS and BDP contributed to the conception or design of the work. US and AG contributed to the acquisition, analysis, or interpretation of data for the work. FS, US, and BDP drafted the manuscript; AG critically revised it. All authors read and approved the final version of the manuscript.

## Conflict of interest disclosure

None.

## Disclosures

None.

## Data availability statement

Research data are not shared.

## Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

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## Appendix A. Supplementary data

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