Cost-effectiveness of a community first responder system for out-of-hospital cardiac arrest in Belgium

Bianca de Greef,[1] Cornelia Genbrugge,[2] Sanjay Verma,[1] Goran Medic,[1] Joachim Maurer,[3] Tom Kooy,[4] Marc Sabbe[2] and Olivier Hoogmartens.[5]

1 Philips, Chief Medical Office – Health Economics and Outcome Research, Amsterdam, the Netherlands, 2 Emergency Department University Hospitals Leuven, Belgium; Department of Public Health and Primary Care, Research Unit Emergency Medicine, KU Leuven, Belgium, 3 Philips, Connected Care – Emergency Care, Amsterdam, the Netherlands, 4 Stan BV, Research Department, the Netherlands, 5 Department of Public Health and Primary Care, Leuven Institute for Healthcare Policy, KU Leuven, Belgium

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Introduction

Out-of-Hospital Cardiac Arrest (OHCA) is a major public health challenge across Europe. Belgium faces similar challenges in managing OHCA, with low survival rates [1].

The chain of survival to improve outcomes emphasizes:
- early recognition,
- rapid emergency medical services (EMS) activation,
- immediate initiation of cardiopulmonary resuscitation (CPR), and
- prompt defibrillation with Automated External Defibrillators (AEDs).

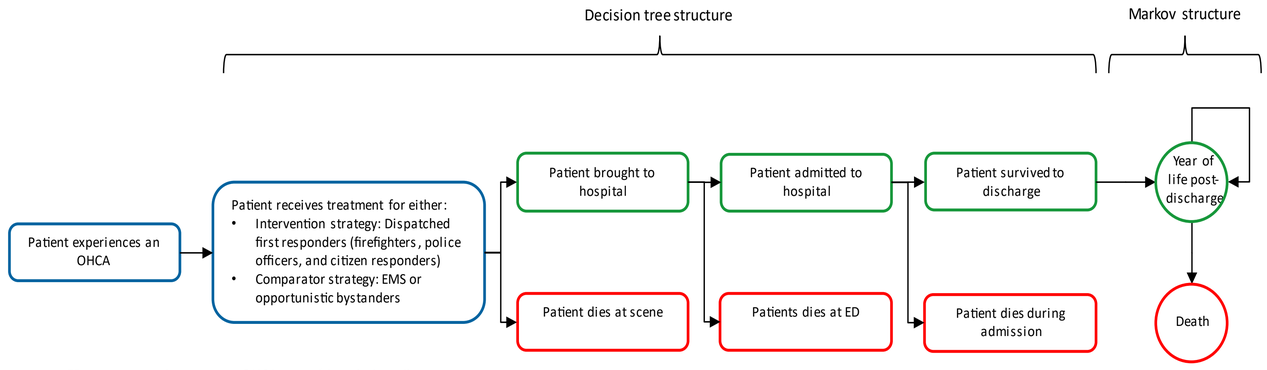
Despite proven benefits and recommendations to place AEDs in public places, their use during OHCA remains low [2]. Community First Responder (CFR) systems can improve survival rates and neurological outcomes, enhancing public health and emergency response [3].

Despite the importance of early intervention, there is little research on the cost-effectiveness of a CFR system Belgium.

Aim

This study evaluates the cost-effectiveness of a 2-scenario approach for implementing a CFR system for witnessed OHCA incidents in Belgium. By comparing the costs and benefits of an optimized CFR system with the current standard of care, this research provides insights to support decision-making and policy development for EMS in Belgium.

Figure 1. *Schematic view of the Decision tree and Markov model*



ED: emergency department; OHCA: out-of-hospital cardiac arrest.

Methods

A cost-effectiveness analysis was performed using a decision tree and long-term Markov model, comparing the costs and quality-adjusted life years (QALYs) of two scenarios with the existing standard of care (figure 1).

Scenario 1: comprehensive OHCA awareness campaign to educate the public on emergency response actions.

Scenario 2: implementation of a CFR system to improve pre-hospital care for OHCA patients. Including: integrating existing AEDs into a nationwide IT network, connecting the system with dispatch centers for a coordinated response, and recruiting and training citizen responders.

The impact of the two scenarios was based on data observed from the Netherlands, specifically drawn from the Amsterdam Resuscitation Study (ARREST) [4] and a prospective registry covering all OHCA cases in the Dutch province of Limburg [5].

The estimated effects were then applied to the Belgian baseline scenario, shown in Table 1.

Belgium does not have an official willingness-to-pay threshold for cost-effectiveness [6].

A univariate deterministic sensitivity analysis (OWSA) and probabilistic sensitivity analysis (PSA) were performed to assess the robustness and uncertainty of the model.

Table 1. *Clinical and cost inputs*

		Scenario 1	Scenario 2
	Baseline	Awareness (30:2 protocol)	CFR system
Clinical inputs			
Survival to ED	0,496 [7]	0,505 Calculated from [4] and [5]	0,528 Calculated from [4] and [5]
Survival to hospital admission	0,867 [7]	0,908 Calculated from [4] and [5]	0,945 Calculated from [4] and [5]
Survival to discharge	0,198 [8]	0,233 Calculated from [4] and [5]	0,279 Calculated from [4] and [5]
CPC 1 **(At hospital discharge)**	0,341 Calculated from [9]	0,3605 Calculated from [4] and [5]	0,3825 Calculated from [4] and [5]
CPC 2 **(At hospital discharge)**	0,341 Calculated from [9]	0,3605 Calculated from [4] and [5]	0,3825 Calculated from [4] and [5]
Cost inputs			
Awareness / recruitment	NA	€550.000	€550.000
Identifying existing AED and availability	NA	NA	€250.000
Training citizen FR	NA	NA	€25
License software (per license per CFR)	NA	NA	€1,50
Integration software dispatch center (per center)	NA	NA	€5.000
EMS training dispatch personnel (per center)	NA	NA	€10.000
Support service (per citizen)	NA	NA	€0,10

AED: automated external defibrillator; CFR: community first responder; CPC: cerebral performance category; ED: emergency department; EMS: emergency medical service; FR: first responder; NA: not applicable.
Survival rates are all calculated when survived previous stage. All costs based on experience of the implementation of the scenarios in the Netherlands, executed by the HartslagNu Foundation (www.hartslagnu.nl) and the Netherlands Heart Foundation. https://www.hartstichting.nl/

Results

The awareness campaign and implementation of the CFR system resulted in incremental cost-effectiveness ratio (ICER) of €14.993 and €16.511 per QALY gained for scenarios 1 and 2, respectively, over a 15-year time horizon, with half-cycle corrections (Table 2).

The analyses demonstrated improvements across all stages, including survival to hospital discharge and neurologically intact survival, CPC 1 and CPC2.

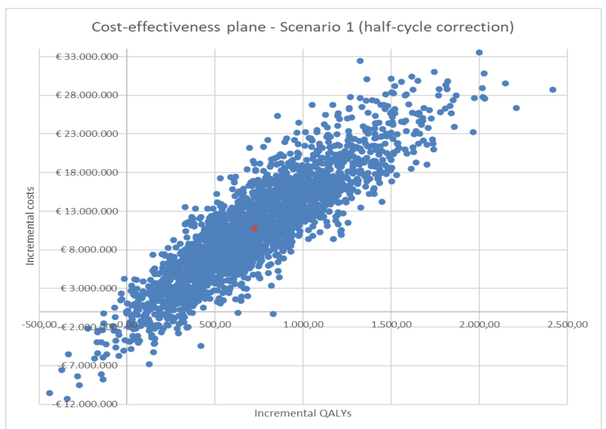
Figure 2 illustrates the cost-effectiveness planes generated from the PSAs, revealing a strong positive correlation between costs and effects.

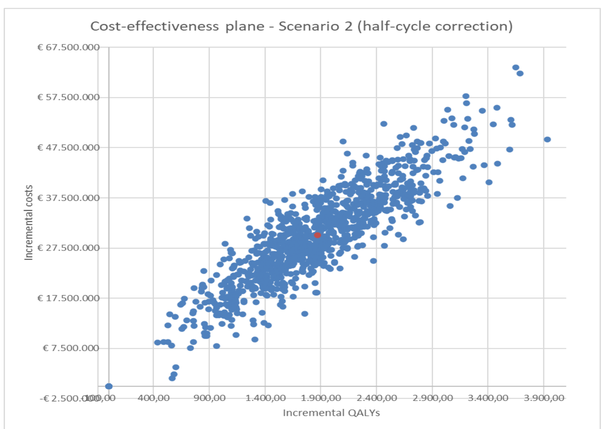
Table 2. *Summary of results for both scenarios, with half-cycle correction (15-year time horizon)*

Scenario 1 – Awareness campaign			
	Current	Proposed	Difference
Total costs	€48.631.878	€58.472.248	€9.840.370
Total QALYs	2.135,55	2.791,90	656,35
Scenario 1: ICER: €14.993			
Scenario 2 – Implementation CFR system			
	Current	Proposed	Difference
Total costs	€48.631.878	€76.104.932	€27.473.054
Total QALYs	2.135,55	3.799,49	1.663,93
Scenario 2: ICER: €16.511			

CFR: Community First Responder; ICER: Incremental Cost-Effectiveness Ratio; QALY: Quality-adjusted life year.

Figure 2. *Cost-effectiveness planes – Scenarios 1 and 2 with half-cycle corrections*





QALY: Quality-adjusted life year

Conclusion

Implementing a CFR system in Belgium represents a cost-effective strategy to:
- improve survival rates following OHCA,
- while delivering favorable outcomes at a reasonable cost per QALY.

This study identifies the potential benefits of strengthening the community first response system in Belgium for patients with OHCA.

The study suggests that the introduction of easily accessible AEDs, the training of CFRs and the establishment of an integrated emergency response system could lead to increased survival rates and improved quality of life for OHCA patients.

These findings may be useful to inform policy and resource allocation decisions in Belgium, with the potential to improve the effectiveness and cost-effectiveness of emergency medical services for OHCA. Furthermore, this approach could serve as a potential model for other regions seeking to improve their emergency response systems for time-sensitive critical conditions.

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Contact

Bianca T.A. de Greef, MD, PhD (bianca.de.greef@philips.com)
Senior Manager Health Economics, Health Economics and Outcome Research
CMO Philips