



## Clinical paper

## Out-of-hospital cardiac arrest without return of spontaneous circulation in the field: Who are the survivors?☆



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## ABSTRACT

**Background:** Return of spontaneous circulation (ROSC) in the field is a vital determinant contributing to survival from out-of-hospital cardiac arrest (OHCA). However, nearly one third of survivors at the Dallas-Fort Worth (DFW) Resuscitation Outcomes Consortium (ROC) site did not obtain ROSC in the field. **Methods:** A retrospective, observational analysis was performed on all adult patients with non-traumatic OHCA treated on scene and transported to hospital, who did not gain ROSC in the field at DFW ROC site between 2006 through 2011. We described the demographics, pre-hospital characteristics and outcomes of all enrolled cases. Those patients without ROSC in the field, who did and did not meet Termination of Resuscitation (TOR) criteria in the field, were also compared.

**Results:** Among a total of 5099 treated and transported non-traumatic OHCA cases, 83.2% (4243) were included in this study as patients without ROSC gained in the field, of which 66.6% (2827) met TOR criteria but still were treated and transported; 1.9% (79) survived to hospital discharge. Further analysis showed that 39.2% (31) of survivors met TOR rule, accounting for 1.1% of those patients who should have been declared dead in the field. Shockable initial rhythms, EMS-witnessed arrest, bystander CPR and age were factors significant to predict survival from OHCA without ROSC in the field. Of concern, 1.7% (47) of patients who met TOR presented initially shockable rhythms but no shocks were delivered in the field.

**Conclusions:** We suggest that all treated non-traumatic OHCA patients should be transported to hospital.

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## Introduction

Out-of-hospital cardiac arrest (OHCA) is a leading cause of death in the world, afflicting an estimated 326,200 persons in the United States per year.<sup>1</sup> Return of spontaneous circulation (ROSC) achieved in the field, which is usually the first goal of immediate resuscitative efforts, is considered as the most crucial factor contributing to survival and favorable neurological outcomes following OHCA. Survival is believed rare without pre-hospital ROSC for OHCA victims.<sup>2</sup> In fact, the Termination of Resuscitation (TOR) criteria, validated

by Morrison LJ et al., which consists of three components including no ROSC achieved, not witnessed by emergency medical services (EMS) providers, and no shock delivered in the field, has been accepted as a universal clinical rule in the 2010 AHA resuscitation guidelines for cessation of resuscitation efforts in pre-hospital setting.<sup>3</sup>

However, the implementation of this universal TOR rule is still challenging due to ethical concerns and thus shows great variation in pre-hospital practice worldwide, even though it has been validated to significantly reduce futile transport for OHCA patients.<sup>4</sup> Many regional EMS agencies including those in the United States have adopted their own local protocols for EMS providers to make decisions for OHCA patients when they did not gain ROSC in the field or even met the TOR rule. The reality is, consequently, as reported by some observational studies, that a certain number of “lucky” victims may survive from OHCA without field ROSC obtained<sup>5</sup> and even some of them should have been terminated and pronounced dead according to the pre-hospital TOR rule.<sup>6,7</sup> In the Dallas-Fort

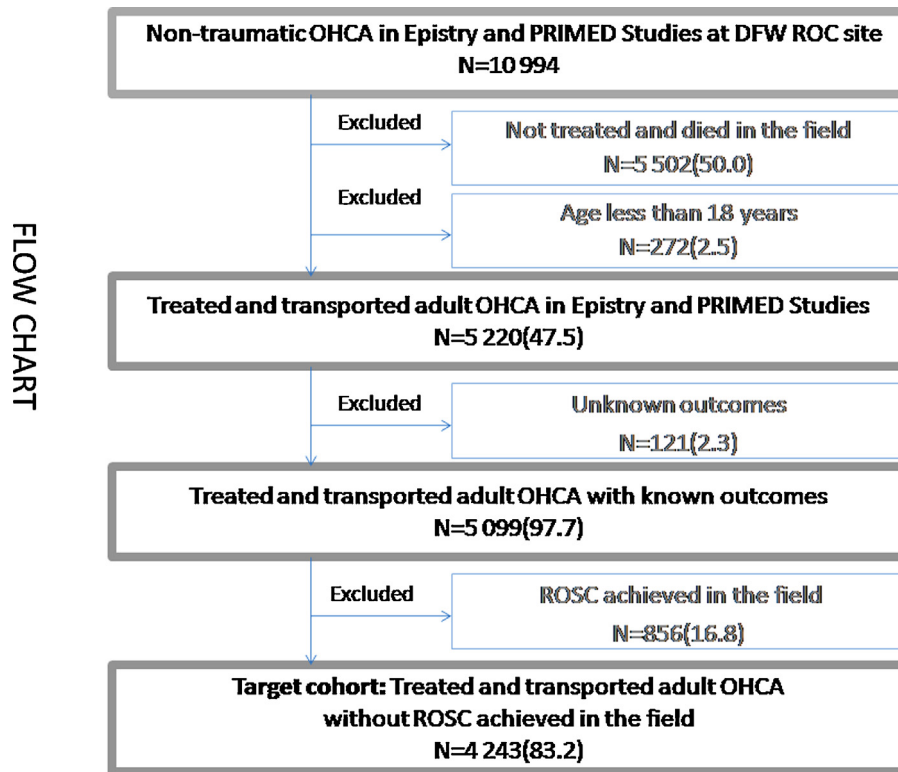
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**Fig. 1.** Target cohort and exclusions. OHCA indicates out-of-hospital cardiac arrest; Epistry, Epidemiological Cardiac Arrest Registry; PRIMED, Pre-hospital resuscitation using an impedance valve and early versus delayed analysis; DFW, Dallas-Fort Worth; ROC, Resuscitation Outcomes Consortium; ROSC, return of spontaneous circulation; N, number.

**Table 1**  
Demographics and characteristics of adult non-traumatic OHCA without ROSC in the field surviving and those not surviving to hospital discharge.

Demographics & characteristics	OHCA without ROSC in the field (N = 4243)	Survived to hospital discharge (N = 79)	Deceased cases (N = 4164)	P
Age, year, mean (SD)	63.0 (17.6)	56.7 (14.5)	63.1 (17.7)	0.000
Male, n (%)	2538 (59.8)	49 (62.0)	2489 (59.8)	0.686
Witnessed by EMS, n (%)	434 (10.2)	17 (21.5)	417 (10.0)	0.001
Bystander CPR, n (%)				0.431
Not attempted	1871 (44.1)	34 (43.0)	1837 (44.1)	
Attempted	1148 (27.1)	26 (32.9)	1122 (26.9)	
Not noted or unknown	1224 (28.8)	19 (24.1)	1205 (28.9)	
Witnessed by bystander, n (%)				0.305
Not witnessed	1944 (45.8)	38 (48.1)	1906 (45.8)	
Witnessed	967 (22.8)	22 (27.8)	945 (22.7)	
Not noted or unknown	1332 (31.4)	19 (24.1)	1313 (31.5)	
Public location, n (%)	537 (12.7)	20 (25.3)	517 (12.4)	0.001
Initial rhythms, n (%)				0.000
VT or VF	645 (15.2)	27 (34.2)	618 (14.8)	
PEA	946 (22.3)	20 (25.3)	926 (22.2)	
Asystole	1997 (47.1)	14 (17.7)	1983 (47.6)	
AED-no shock advised	37 (0.9)	0 (0.0)	37 (0.9)	
Cannot determine or missing	618 (14.6)	18 (22.8)	600 (14.4)	
EMS response time, min, mean (SD)	4.6 (3.6)	4.4 (4.5)	4.6 (3.6)	0.593
Shock delivered in the field, n (%)	1057 (24.9)	34 (43.0)	1023 (24.6)	0.000
Field resuscitation interval, min, mean (SD)	19.2 (9.7)	15.5 (9.3)	19.2 (9.6)	0.001
Met TOR criteria, n (%)	2827 (66.6)	31 (39.2)	2796 (67.1)	0.000

OHCA indicates out-of-hospital cardiac arrest; ROSC, return of spontaneous circulation; SD, standard deviation; EMS, emergency medical services; CPR, cardio-pulmonary resuscitation; VT, ventricular tachycardia; VF, ventricular fibrillation; PEA, pulse-less electrical activities; AED, automatic external defibrillator; TOR, Termination of Resuscitation; min, minute; n, number; N, number.

Worth (DFW) Resuscitation Outcomes Consortium (ROC) site, data showed that nearly one third of survivors were patients who did not have ROSC in the field. In this study we described the characteristics and outcomes of adult patients with non-traumatic OHCA treated on scene without ROSC gained in the field and transported to hospital at the DFW ROC site, and compared those who did and did not meet TOR rule in the field as well.

**Methods**

*Study population*

Resuscitation Outcomes Consortium (ROC) is a network of 10 regional research centers in North America and a data coordinating center (DCC) in the United States that conducts research focused

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