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► **To cite this version:**

Alexis Descatha, François Morin, Marc Fadel, Thomas Bizouard, Romain Mermillod-Blondin, et al.. Cardiac Arrest Management in the Workplace: Improving but Not Enough?. Safety and Health at Work, 2023, 14 (1), pp.131-134. 10.1016/j.shaw.2022.12.004 . hal-04088589

**HAL Id: hal-04088589**

**<https://hal.science/hal-04088589>**

Submitted on 31 May 2023

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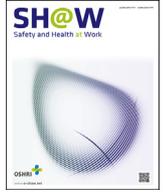


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Contents lists available at ScienceDirect

## Safety and Health at Work

journal homepage: [www.e-shaw.net](http://www.e-shaw.net)

## Short Communication

## Cardiac Arrest Management in the Workplace: Improving but Not Enough?



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## ARTICLE INFO

## Article history:

Received 17 August 2022

Received in revised form

16 December 2022

Accepted 30 December 2022

Available online 4 January 2023

## Keywords:

cardiac arrest

location

occupational

public health

work

## ABSTRACT

The aim was to describe out-of-hospital cardiac arrest (OHCA) occurring in the workplace of a large emergency network, and compare the evolution of their management in the last 15 years. A retrospective study based on data from the Northern Alps Emergency Network compared characteristics of OHCA between cases in and out the workplace, and between cases occurring from January 2004 to December 2010 and from January 2011 to December 2017. Among the 15,320 OHCA cases included, 320 occurred in the workplace (2.1%). They were more often in younger men, and happened more frequently in an area with access to public defibrillation, had more often a shockable rhythm, had a cardiopulmonary resuscitation started by a bystander more frequently, and had a better outcome. Cardiopulmonary resuscitation started by a bystander was the only chain of survival link that improved for cases occurring after December 2010. Workplace OHCA seems to be managed more effectively than others; however, only a slight survival improvement was observed, suggesting that progress is still needed.

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Out-of-hospital cardiac arrest (OHCA) remains a leading cause of mortality among adults in the world [1]. Many improvements of the OHCA management have been made in the last two decades [2]. However, the overall prognosis and neurological outcomes are relatively poor following OHCA, with few improvements during the past three decades [3], though these outcomes have improved for in-hospital cardiac arrest cases [4].

Although OHCA cases in the workplace are rare, they have singularities compared to other locations in terms of population and chain of survival [5,6]. OHCA in occupational settings are associated with a

better immediate prognosis than OHCA cases occurring elsewhere, and the number of years of life saved is generally high because of the age of the victims. However, even though some studies have focused on workplace location management and outcomes [7–11], the evolution of OHCA management in the last 15 years is yet to be evaluated.

After describing OHCA cases occurring in the workplace of a large emergency network, we aimed to analyze the evolution of the management of OHCA in the last 15 years.

An observational, retrospective study was conducted using data of all OHCA cases collected from the Northern French Alps

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<https://doi.org/10.1016/j.shaw.2022.12.004>

Emergency Network from January 2004 to December 2017. A focus on the location of cardiac arrest (workplace or not) and on the evolution of collected variables was made. The Northern French Alps Emergency Network is formed by all the hospitals in three counties (Isère, Savoie, and Haute-Savoie), including 13 Mobile Emergency, and Resuscitation Services. This network allows to collect data for the cardiac arrest registry of the Northern French Alps (RENAU AC), which is an exhaustive registry that follows the Utstein Style, and is set in a mountain area [12,13]. Since the first of January 2004, each out-of-hospital cardiac arrest case has been recorded in an electronic form completed by the emergency physician in charge of the patient, and the dispatch center.

Utstein relevant variables such as age (considered as continuous, and in four categories: 0–18 years, 18–40 years, 40–60 years, and 60 years and more), gender (male or female), presence of bystanders (yes or no), bystander cardiopulmonary resuscitation (CPR) (yes or no), location of the OHCA (workplace or not), shockable rhythm (yes or no), and intervention times were included. Patient status (alive/dead, and using standardized cerebral performance category [CPC] score) was obtained at Day 30 from the receiving unit, or via phone interviews with research associates, asking if hospital discharge had occurred. The survival rate included

return of spontaneous circulation at scene, admitted alive at hospital, and survival at 30 days, with good neurological status (CPC 1 & 2).

The first part of the analysis was the comparison of the characteristic and survival of OHCA cases occurring in the workplace and those outside of the workplace. For this,  $\chi^2$  tests were used for the comparison of percentage. The second part of the analysis consisted in the assessment of the evolution of OHCA in the workplace during the study period. For this, cases were categorized into two 7-year periods: the period from January 2011 to December 2017 was compared to a reference period starting from January 2004 to December 2010. Likely, appropriate bivariate analyses comparing the characteristics of OHCA occurring in the most recent period to the reference period were carried out. Adjusted logistic models assessing the risk of three survival outcomes, with the period of occurrence of OHCA, were computed. Statistical analyses were all performed using SAS (Statistical Analysis Software, v. 9.4 SAS Institute Inc., Cary, NC, USA). A *p*-value of <0.05 was considered statistically significant. The study complied with the Declaration of Helsinki, and was approved by the ethics committee of the University Hospital of Clermont-Ferrand, Clermont-Ferrand, France (IEC no. 5891). The RENAU AC registry, including the method of

**Table 1**  
Description of the sample with comparison of all OHCA and OHCA occurring in the workplace

	Total OHCA	Number of OHCA in the workplace (% of total OHCA)	Number of OHCA out of the workplace (% of total OHCA)	<i>p</i> -value
<b>Sex</b>				
Women	4635	29 (0.6%)	4606 (99.4%)	(Reference)
Men	10779	291 (2.7%)	10488 (97.3%)	<.0001
<b>Age</b>				
0–18 years	352	0 (0%)	352 (100%)	ns
18–40 years	1288	60 (4.7%)	1228 (95.3%)	(Reference)
40–60 years	3716	209 (5.6%)	3507 (94.4%)	ns
≥60 years	10059	51 (0.5%)	10008 (99.5%)	<.0001
<b>Witness</b>				
No	4051	75 (1.9%)	3976 (98.1%)	(Reference)
Yes	11223	244 (2.2%)	10979 (97.8%)	ns
<b>Etiology</b>				
Non cardiac	5373	124 (2.3%)	5249 (97.7%)	(Reference)
cardiac	10035	196 (2.0%)	9839 (98%)	ns
<b>Public access defibrillation</b>				
No	12137	236 (1.9%)	11901 (98.1%)	(Reference)
Yes	205	11 (5.4%)	194 (94.6%)	0.0009
<b>Shockable rhythm</b>				
No	12117	204 (1.7%)	11913 (98.3%)	(Reference)
Yes	3119	115 (3.7%)	3004 (96.3%)	<.0001
<b>Bystander cardiopulmonary resuscitation</b>				
No	10562	201 (1.9%)	10361 (98.1%)	(Reference)
Yes	4318	116 (2.7%)	4202 (97.3%)	0.0028
<b>Return of spontaneous circulation</b>				
No	10498	192 (1.8%)	10306 (98.2%)	(Reference)
Yes	4136	124 (3.0%)	4012 (97%)	<.0001
<b>Admitted hospital alive</b>				
No	11482	208 (1.8%)	11274 (98.2%)	(Reference)
Yes	3151	108 (3.4%)	3043 (96.6%)	<.0001
<b>Survival at day 30 with good neurological outcome</b>				
No	13707	272 (2.0%)	13435 (98%)	(Reference)
Yes	904	43 (4.8%)	861 (95.2%)	<.0001
<b>Period</b>				
2004–2010	7040	154 (2.2%)	6886 (97.8%)	(Reference)
2011–2017	8375	166 (2.0%)	8209 (98%)	ns

NS =  $p \geq 0.05$ .

monitoring patient survival, was also validated by the appropriate ethic committee.

Between 2004 and 2017, 15,320 OHCA cases that had a location reported were included. Among them, 320 cases occurred in the workplace (2.1%). OHCA cases occurring in the workplace were more often men, younger, happened more frequently in an area with access to public defibrillation, had more often a shockable rhythm, had a CPR started by a bystander more frequently, and had a better outcome (Table 1).

The comparing data of the recent seven years period to the reference period highlighted that having a CPR started by a bystander was the only chain of survival improved (Table 2). Indeed, CPR was started by a bystander in approximately 46% or more cases in the most recent period compared to the reference period. Though the rates of return of spontaneous circulation at scene and admitted alive at a hospital were not statistically different, survival at 30 days with good neurological status (CPC 1 & 2) was better: 67.4% cases had good neurological outcome in the most recent period compared to 32.6% of cases in the reference period.

Adjusted logistic analyses confirmed the previous results, and found statistically better survival outcomes for both the place of occurrence and period of occurrence, with adjusted

odds ratio ranging from 1.29 (95% CI, 1.17-1.42) to 2.00 (95% CI, 1.67-2.40).

OHCA in the workplace appears to be managed more effectively than OHCA occurring in other places, which encourages setting up first-aid programs in certain companies [14]. However, there is only a slight survival improvement in the management of OHCA at the workplace, with higher rate of cardiopulmonary resuscitation started by a bystander, leaving room for significant improvements.

OHCA in the workplace is a rare event that represents between 1 and 10% of all OHCA cases. In most studies, the workplace is one of the least frequent sites of OHCA [5,15–18], regardless of the type of workplace [19]. Nevertheless, the number of years of life saved is generally high, and some authors, including us, have found that patients experiencing OHCA in the workplace presented one of the highest hospital discharge survival rates [5,6,18]. Indeed, OHCA tends to occur in young people, and the survival chain is better than elsewhere [5,18]. This points out the importance of continuing to improve the management of OHCA occurring in the workplace.

Different limitations should be discussed. First, we used the Northern French Alps Emergency Network with the RENAU OHCA. It is not a nationwide register, but the proportion of OHCA and survival is similar to the previous data from a national register [11], with a good exhaustivity [13]. The quality of data since 2004 and its

**Table 2**  
Comparison of OHCA occurring in the workplace in the first period and the second period

	Total OHCA in the workplace	Number of OHCA in the workplace 2004-2010 (% of total OHCA)	Percentage of OHCA in the workplace out of all OHCA occurring between 2004-2010	Number of OHCA in the workplace 2011-2017 (% of total OHCA)	Percentage of OHCA in the workplace out of all OHCA occurring between 2011-2017	p-value
<b>Sex</b>						
Women	29	14 (48.3%)	9.1%	15 (51.7%)	9.0%	(Reference)
Men	291	140 (48.1%)	90.9%	151 (51.9%)	91.0%	ns
<b>Age</b>						
18-40 years	60	31 (51.7%)	20.1%	29 (48.3%)	17.0%	(Reference)
40-60 years	209	106 (50.7%)	68.8%	103 (49.3%)	62.0%	ns
≥60 years	51	17 (33.3%)	11.1%	34 (66.7%)	21.0%	ns
<b>Witness</b>						
No	75	40 (53.3%)	26.0%	35 (46.7%)	21.2%	(Reference)
Yes	244	114 (46.7%)	74.0%	130 (53.3%)	78.8%	ns
<b>Etiology</b>						
Non cardiac	124	56 (45.2%)	36.4%	68 (54.8%)	41.0%	(Reference)
cardiac	196	98 (50.0%)	63.6%	98 (50.0%)	59.0%	ns
<b>Public access defibrillation</b>						
No	236	79 (33.5%)	96.3%	157 (66.5%)	95.2%	(Reference)
Yes	11	3 (27.3%)	3.7%	8 (72.7%)	4.8%	ns
<b>Shockable rhythm</b>						
No	204	104 (51.0%)	67.5%	100 (49.0%)	61.0%	(Reference)
Yes	115	50 (43.5%)	32.5%	65 (56.5%)	39.0%	ns
<b>Bystander cardiopulmonary resuscitation</b>						
No	201	107 (53.2%)	69.5%	94 (46.8%)	57.7%	(Reference)
Yes	116	47 (40.5%)	30.5%	69 (59.5%)	42.3%	0.03
<b>Return of spontaneous circulation</b>						
No	192	99 (51.6%)	64.3%	93 (48.4%)	57.4%	(Reference)
Yes	124	55 (44.4%)	35.7%	69 (55.7%)	42.6%	ns
<b>Admitted hospital alive</b>						
No	208	107 (51.4%)	69.5%	101 (48.6%)	62.3%	(Reference)
Yes	108	47 (43.5%)	30.5%	61 (56.5%)	37.7%	ns
<b>Survival at day 30 with good neurological outcome</b>						
No	272	140 (51.5%)	90.9%	132 (48.5%)	82.0%	(Reference)
Yes	43	14 (32.6%)	9.1%	29 (67.4%)	18.0%	0.02

NS =  $p \geq 0.05$ .

stability allowed comparison of different periods of time [20], with improved location coding over time. Second, the definition of “workplace” can be ambiguous. There is a large heterogeneity of workplaces, from small shop to large offices, and now including home teleworking. However, a global comparison is possible, considering the overall public health aim. Third, it was only possible to compare data before the COVID pandemic, and not the recent ones. Indeed, we know that the COVID pandemic will have major consequences on OHCA, but it will need to wait to have stabilized and clean data.

With the many efforts in many countries of emergency specialists and occupational and public health practitioners, our results showed that the management of OHCA occurring in the workplace has improved, but pursuing efforts to allow better outcomes is needed, which emphasizes on the importance of continuing this global prevention task.

### Conflict of interest

Authors are paid by their institution; AD is also paid as editor of the *Archives des Maladies professionnelles et de l'Environnement* (Elsevier).

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.shaw.2022.12.004>.

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