

# 2022: Are We Back to the pre-COVID-19 Pandemic Period in the Management of out-of-Hospital Cardiac Arrest?

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## SUMMARY

**Introduction:** The COVID-19 pandemic caused a significant strain on the Emergency system, particularly for time-dependent diseases like Out of Hospital Cardiac Arrest (OHCA). Studies have shown an increase in the incidence of OHCA during different waves of the pandemic, but there is limited evidence on how survival rates and rescue efforts have been affected in the post-pandemic period.

**Methods:** We performed a retrospective observational cohort study of all OHCA rescues by AREU (Agenzia Regionale Emergenza Urgenza), in the Lombardy region in March in three different years (2019, 2021 and 2022). We used rescue mission data collected in AREU's database, where logistic information of patient rescue missions managed by the Lombardy Region's 112 system is recorded.

**Results:** This study was an epidemiology analysis of OHCA after the pandemic. The results showed no significant changes in the probability of receiving bystander cardiopulmonary resuscitation (22.5% vs 24.0%;  $p=0.41$ ) and public access defibrillation (3.6 vs 3.2;  $p=0.50$ ) compared to pre-pandemic period. However, there was a decrease in the probability of ROSC (11.5% vs 6.2%;  $p<0.01$ ).

**Conclusion:** According to our analysis, there appears to be a return to the pre-pandemic phase with regard to the OHCA network. However, it remains to be pointed out that a careful study of disease networks is essential to understand the resilience of our health system and to understand whether we have returned to a system similar to the pre-pandemic phase after the COVID-19 pandemic.

**Keywords:** COVID-19; Resuscitation; Out-of-Hospital cardiac arrest; Emergency Medical Service.

## INTRODUCTION

The COVID-19 pandemic had a significant impact on the Emergency Medical Services (EMS), with Italy being the first country to be involved [1-2]. Several changes were observed in the EMS, including the frequency and nature of hospital patients' access [3-4] as well as the epidemiological modification of diagnosed diseases. Additionally, many changes were recorded in the single European Emergency Number (NUE) 112 [5], particularly regarding time-dependent pathologies [6]. All the aforementioned factors resulted in a need for the reorganization of the Italy's EMS system, which included among others the telemedicine protocols, the

restructuring of the hospital network and the adoption of remote work practices [7]. The Out of Hospital Cardiac Arrest (OHCA) network was influenced by two factors during the COVID-19 pandemic. Firstly, the social distancing, and then the spread of the virus [8]. Social distancing reduced the likelihood of early bystander cardiopulmonary resuscitation (CPR), while COVID-19 led to a decrease in basic life support training [9], which affected the ability of bystanders to recognize and manage OHCA. Additionally, the fear of contracting the virus made bystanders less eager to perform CPR. In 2020, there was a higher frequency of OHCA at home compared to 2019 (82.2% vs 87.3%) where access to defibrillators is limited. Our research [10] indicates a decrease in bystanders CPR during

the first pandemic wave in March 2020 compared to March 2019 (0.73 [0.60–0.88];  $p = 0.0008$ ); an increase in OHCA cases at home and a reduced use of public access defibrillators (PAD) (0.44 [0.27–0.72];  $p = 0.0009$ ) [10].

The objective of this study was to assess the state of pre-hospital management of OHCA in the Lombardy region, with the aim of determining whether conditions are currently similar to those experienced prior to the onset of the COVID-19 pandemic. The EMS missions in Lombardy region are coordinated by AREU (Regional Emergency and Urgency Agency) [11] and all data from the mission are recorded in the EmMa (Emergency Management) regional portal by rescue team.

## METHODS

A retrospective observational cohort study was conducted in the Lombardy region following the principles outlined by the Declaration of Helsinki. The study analysed EMS rescue data of the Lombardy region recorded on EmMa (Emergency Management system). EmMa is a software that collects all the logistical information of the rescue, necessary to analyse the timing of the rescue and where to reach the patient. Information about the event's location and the patient's emergency is needed to decide which vehicle to send to the scene (helicopter, basic medical vehicle or advanced medical vehicle). All vehicles are linked to a GPS system for logistical reasons and all information is collected during the mission and made available anonymously and aggregated for analysis on the EMS system. The aim was to explore the impact of the pandemic across three distinct periods - March 2019 (pre-COVID-19), March 2020 (first peak of the pandemic) and March 2022 (post pandemic) in alignment with the Italian COVID-19 timeline [12]. The categorical variables are presented as number and percentage and Z test for proportion was applied. Continuous variables are presented as mean and standard deviation (SD). Continuous variables were tested for normality by Kolmogorov–Smirnov test and Z test for means was applied. Differences were considered significant with  $p < 0.05$ , otherwise, they were considered non-significant (NS). The Prism 8.0.1 statistical software (GraphPad Software LLC, San Diego, CA, USA) was used to this aim.

## RESULTS

In March 2019, a total of 1,097 cases of out-of-hospital cardiac arrest (OHCA) were reported, with (57,3%) cases occurring in males. The following year, in March 2020, the number of OHCA cases increased to 1,767, with 1020 (57,8%) cases in males. However, in March of 2022, the total number

of OHCA cases decreased to 995, with 570 (57,3%) cases in males (data not shown). These data indicate that males had a higher incidence of OHCA cases compared to females in all three years. Furthermore, unknown sex cases were an insignificant proportion of the total OHCA cases examined. Regarding the place where OHCA occurred during the three examined periods, In March 2019, 856 out of the total cases took place at home, representing 78% of the total. In March 2020, the number of OHCA at home increased to 1644, accounting for 93% of the total. By March 2022, the number of OHCA at home decreased to 855, representing 86% of the total. The remaining number of OHCA cases occurred in other places (data not shown).

As shown in Table 1, results suggest that the mean age of OHCA cases has increased over time, but the standard deviation has fluctuated. It is important to note that these results are limited to the month of March and may not be representative of OHCA cases throughout the entire year. On March 2022 a total of 995 OHCA was recorded on Emergency Management (EmMa), accounting for 10,3% of total OHCA registered in 2022. There was a statistically significant rise in the percentage of diagnoses as compared to March 2019, which saw 1097 cases (9,0%) ( $p < 0.01$ ). However, there was a decrease as compared to March 2020, which recorded 1767 cases (13.2%) ( $p < 0.01$ ), coinciding with the first wave.

Table 1: Mean age, standard deviation (SD) and p value of OHCA cases for three different years, March of 2019, March of 2020, and March of 2022

Year	Mean age	SD	p value
mar-19	73,9	16,6	
mar-20	75,7	13,8	$p < 0,05^*$
mar-22	75,2	15,9	$p < 0,05^*$

\*Z test for means; compared to March 2019

As shown in Table 2, there was no significant difference in the likelihood of receiving bystander CPR performed by lay individuals in March 2019 (22.5%) and March 2022 (24.0%) ( $p = 0.41$ ). Additionally, there was no significant change in the probability of being rescued using a PAD (3.6% vs 3.2%;  $p = 0.50$ ). However, the chances of achieving ROSC were considerably lower in 2022 compared to 2019 (11,5% vs 6,2%;  $p < 0.01$ ).

Table 2: Characteristics of OHCA rescue in March of three different periods

	2019 N (%)	2020 N (%)	2022 N (%)
OHCA in March	1097	1767	995
bystander CPR	247 (22.5)	308 (17.4)	239 (24.0)
PAD	40 (3.6)	29 (1.6)	31 (3.2)
ROSC	126 (11.5)	40 (2.3)	61 (6.2)*

OHCA= out-of-hospital cardiac arrest; CPR= cardiopulmonary resuscitation; PAD= public access defibrillation; ROSC= Return of spontaneous circulation. \*Z test for proportion<0.01; compared to March 2019

## DISCUSSION

Based on data emerging from a simple analysis of one variable, it has become clear that the epidemiology of OHCA has undergone some changes. Firstly, the majority of cases occurred at home during the inter-pandemic period, due to restriction policies, and the percentage of cases in the post-pandemic period only slightly decreased, compared to pre-pandemic period. Males had a higher incidence of OHCA cases in all three years analysed. Furthermore, while percentage of bystander CPR and PAD access have returned to 2019 levels, ROSC remained approximately 5% lower than pre-pandemic period. Many factors could have contributed, but it is worth noting that lay rescuers' response during arrests is now in line with the pre-pandemic period. The COVID-19 pandemic has heavily impacted EMS organization, and continuous analysis of rescue efforts and the development of an epidemiological observatory are essential to ensuring a return to pre-pandemic effectiveness. Moreover, the EMS was among the first to register changes in its organization during the pandemic's first wave. Finally, networks analysis could be helpful, even during inter-pandemic periods, as it will aid in predicting new pandemic waves identifying potential alerts.

The analysis of COVID-19 impact, through data collected by the EMS system, is necessary. In fact, in addition to time-dependent pathologies, the EMS system has recorded other relevant changes, in no time depend pathologies [13-15]. For this reason, carrying out retrospective observational studies is relevant, also to plan the new pandemic preparedness statement [16].

The data highlight some differences from the research published by Marijon et al. [8], which showed an increase in OHCA at home similar to our data (90.2 vs 93.0%) and a reduction in ROSC of 10%, whereas in our study it was 5.3%. Unfortunately, this last data is difficult to compare because all cardiac arrests were included in our analysis, and we considered ROSC only if achieved on the scene by the rescue crew. Whereas, Marijon et al. analysed the mortality in the Emergency Department. But previous research highlights ROSC reduction linked by a reduction of bystander Resuscitation [17].

However, data are collected by the EMS dispatched centres [18], thus one possible limitation of our study is a reduced occurrence of data entry during an emergency call, especially during COVID-19 pandemic [19]. Moreover, as a retrospective study, the changes recorded could be linked to other phenomena, which emerged in the post-pandemic phase, and should not be linked to COVID-19 only. As shown in previous studies, March is a month in which a variation in ROSC achievement is observed, this phenomenon is unclear, but could be related to the flu season and the beginning of spring [20] or other meteorological factor [21-23]. Finally, analysing all type of cardiac arrests might lead to different bias. Indeed, the epidemiology of trauma events has changed during the pandemic [4,7,24], and the rate of ROSC may be influenced [25].

In conclusion in the post-pandemic phase, the use of the Public Access Defibrillator and by standard cardiopulmonary resuscitation was in alignment with the pre-pandemic phase. However, we highlight a slight reduction in the return on spontaneous circulation compared to the pre-pandemic phase.

## AUTHORS' CONTRIBUTIONS

GS conceived and designed the study; GS and GR collected and analysed the data; GS, GMS and AA interpreted the results of the experiments; GS drafted the first version of the manuscript; all authors edited, revised the manuscript, and approved the final version before submission.

## ETHICS

Ethical approval for this study was not required because we used aggregated data collected for administrative purpose.

## CONFLICTS OF INTEREST

None declared.

## INFORMED CONSENT STATEMENT

Patient consent was waived by the IRB due to the retrospective nature of the study.

## DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author.

## FINANCIAL SUPPORT

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