Available online at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

# Resuscitation of older adults in Norway; a comparison of survival and outcome after out-of-hospital cardiac arrest in healthcare institutions and at home

*Astrid K.V. Harring*[a,*], *Jo Kramer-Johansen*[b,c], *Ingvild B.M. Tjelmeland*[b,c]

## Abstract

**Background**: Perceptions about expected outcome after out-of-hospital cardiac arrest (OHCA) influence treatment decisions, and there is a need for updated evidence about outcomes for the elderly.

**Method**: We conducted a cross-sectional study of cases reported to the Norwegian Cardiac Arrest Registry from 2015 through 2021 of patients 60 years and older, suffering cardiac arrest in healthcare institutions or at home. We examined reasons for emergency medical service (EMS) withholding or withdrawing resuscitation. We compared survival and neurological outcome for EMS-treated patients and explored factors associated with survival using multivariate logistic regression.

**Result**: We included 12,191 cases and the EMS started resuscitation in 10,340 (85%). The incidence per capita of OHCA the EMS were alerted to was 267/100,000 in healthcare institutions and 134/100,000 at home. Resuscitation was most frequently withdrawn due to medical history ($n = 1251$). In healthcare institutions, 72 of 1503 (4.8%) patients survived to 30 days compared to 752 of 8837 (8.5%) at home ($P < .001$). We found survivors in all age cohorts both in healthcare institutions and at home, and most of the 824 survivors had a good neurological outcome with a Cerebral Performance Category $\leq 2$ (88%).

**Conclusion**: Medical history was the most frequent reason for EMS not to start or continue resuscitation, indicating a need for a discussion about, and documentation of, advance directives in this age group. When EMS attempted resuscitation, most survivors had a good neurological outcome, both in healthcare institutions and at home.

**Keywords**: Cardiopulmonary resuscitation, CPC, Do-not-resuscitate, Elderly, Emergency medical services, Out of hospital cardiac arrest, Nursing home

## Background

Cardiopulmonary resuscitation (CPR) can sometimes reverse sudden death due to cardiac arrest but cannot defy imminent death due to high age or severe morbidity. In out-of-hospital cardiac arrest (OHCA) situations, the arriving emergency medical services (EMS) personnel must quickly decide to start or refrain from CPR, often based on limited patient information.

There can be medical and ethical reasons to withhold and withdraw resuscitation attempts.[1–9] An international study found that the elderly more often experienced early withdrawal of life-support compared to younger patients.[10] Even though a patient's age alone should not decide if CPR is started,[9] older age is associated with reduced survival.[2,5,11,12] The elderly are known to have co-morbidities,[2,5,11] and those in healthcare institutions, even more so than people living at home. Reported outcomes after OHCA in healthcare institutions vary,[1–2,5,11,13,14] and the number of people living in these institutions may increase with the ageing population. It is, therefore, essential to have updated knowledge as preconceptions of patients' outcomes will influence resuscitation efforts and survival.

In this study, we compared characteristics for OHCA patients 60 years and older suffering cardiac arrest in healthcare institutions and at home. Survival and neurological outcome for EMS-treated

* Corresponding author at: Oslo Metropolitan University, PB 4, St. Olavs Plass, 0130 Oslo, Norway.
E-mail address: astridka@oslomet.no (A.K.V. Harring).

https://doi.org/10.1016/j.resuscitation.2023.109871
Received 6 April 2023; Received in Revised form 6 June 2023; Accepted 7 June 2023

patients were compared to identify factors associated with survival. In addition, we investigated reasons for EMS personnel to withhold or withdraw resuscitation.

### Methods and material

This retrospective, cross-sectional study used data from the Norwegian Cardiac Arrest Registry (NorCAR). In Norway, cardiac arrest is a reportable condition, and the registry covers the entire population. The patient's personal identity number links the registry to the National Population Register. Local data managers enter patient information into NorCAR using information from dispatch, ambulance and in-hospital records. The data managers may estimate the Cerebral Performance Category (CPC) score at discharge using the patient's hospital record whenever CPC is not stated explicitly.[15]

### Study population and study setting

We included all patients 60 years and older with a Norwegian personal identity number, registered in NorCAR between 1. January 2015 and 31. December 2021, who received CPR or defibrillation by bystander, first responder, or EMS. The place of cardiac arrest had to be either in a healthcare institution or at home. Only the first cardiac arrest was included for patients suffering more than one cardiac arrest within 30 days.

Definition in NorCAR for healthcare institution is a nursing home, private healthcare facility, X-ray clinic and psychiatric centre. The definition of home is a home or apartment, including backyards.[16] If the EMS does not start CPR, the reason is registered as either; there was no cardiac arrest when EMS arrived (signs of life), CPR is considered futile (futile), there is a do-not-resuscitate order (DNAR), medical history indicates the patients should not be resuscitated (medical history), or unknown. Similarly, why CPR was terminated should be documented, and the options are; the patient has return of spontaneous circulation (ROSC), no ROSC was achieved, medical history, DNAR, other and unknown.

The number of inhabitants 60 years and older in Norway increased from 1,121,796 in 2015 to 1,275,394 in 2021.[17] The population at risk during these 7 years was 8,363,640. The number of adult beds in health-and care institutions decreased from 104,021 in 2015 to 101,769 in 2021.[18] The total available adult beds in health-and care institutions in the study period were 722,809. The total available places were subtracted from the population at risk to calculate the incidence per 100,000 according to place of arrest.[19]

### Outcomes

The primary outcome in this study was 30-day survival. Survival is automatically calculated in NorCAR as the registry is linked to the National Population Register. The system collects the date of death and the date of cardiac arrest and returns 30-day survival based on this information.

When reporting survival and neurologic outcomes, only patients treated by EMS or those successfully resuscitated by an automated external defibrillator (AED) before EMS arrival (ROSC by AED) were included. The registry uses Cerebral Performance Category (CPC) to describe the patients' neurological status at discharge. A favourable CPC score was defined as CPC 1 or 2, and a poor neurological outcome was defined as a CPC score of 3 or 4.[2] Resuscitation characteristics and outcomes were compared between the age groups in 10-year cohorts.

### Statistical analysis

Descriptive statistics are presented as frequencies and percentages for categorical variables and means with standard deviation (SD) for continuous variables. All EMS-witnessed cardiac arrests are excluded when calculating bystander CPR rates and response intervals. EMS response interval is reported as median, with 25 (Q1) and 75 (Q3) percentiles. Chi-square was used for categorical variables when comparing OHCA in institutions with the home group and for the post-hoc test in Table 4.

Multivariate logistic regression was performed on cases where EMS attempted resuscitation or patients that had achieved ROSC by AED, to identify factors associated with survival in both groups. EMS-witnessed arrests were not included in the analyses as information about bystander CPR does not apply for this group. Cases with response intervals longer than 70 mins were also excluded. Variables were recoded into binary variables. The significance level was set to a P-value of $\leq$0.05. Statistical analyses were performed using SPSS Version 27.0 (IBM Corporation) or STATA Version 17 (StataCorp).

### Ethics

According to Norwegian legislation, data collection in NorCAR is mandatory and does not require informed consent from patients or relatives.[15] We used anonymised data provided by NorCAR. The Regional Medical Ethics committee (reg. nr. 2018/2301) and the Data Protection Official at Oslo University Hospital approved this study (nr. 19–00662).

## Results

A total of 12,191 cases of OHCA were included from NorCAR during the seven years (Fig. 1). Patients in healthcare institutions were on average 5 years older (P <.001) and were more often female (P <.001) compared to patients suffering cardiac arrest at home (Table 1). The median response interval was 7 minutes (Q1: 5, Q3: 11) for healthcare institutions and 9.5 minutes (Q1: 7, Q3: 14) for OHCA at home.

The EMS initiated or continued CPR in 10,317 (85%) cases, 1495 of the 1931 (77%) in healthcare institutions and 8822 of 10,260 (86%) at home (P <.001). Excluding EMS witnessed arrests, the bystander CPR rate was significantly higher in healthcare institutions 1617 of 1931 (93%) than at home 7208 of 10,260 (77%) (P <.001). Cardiac arrest was also more often witnessed in healthcare institutions (Table 1), with a witnessed percentage of 72% versus 59% at home (P <.001).

The yearly incidence of OHCA the EMS responded to was 145 per 100,000 capita $\geq$60 years. Incidence according to place of arrest per 100,000 capita was 267 for OHCA in healthcare institution and 134 at home. The incidence of EMS confirmed OHCA for those $\geq$60 years was 135/100,000 capita, however the EMS did not attempt resuscitation in all cases. When including those initially resuscitated by an AED, the EMS attempted resuscitation in 208 per 100,000 capita in healthcare institution and 115 per 100,000 capita at home. The 30-day survival in healthcare institutions per 100,000 capita was 10 compared to 9.8 at home (Supplementary Fig. 1).

In total 824 (8%) of the 10,340 patients survived to 30 days and most survived to 1 year (Table 2). Initial rhythm was non-shockable for 324 of 824 (39%) of the survivors, of whom 48 had unwitnessed

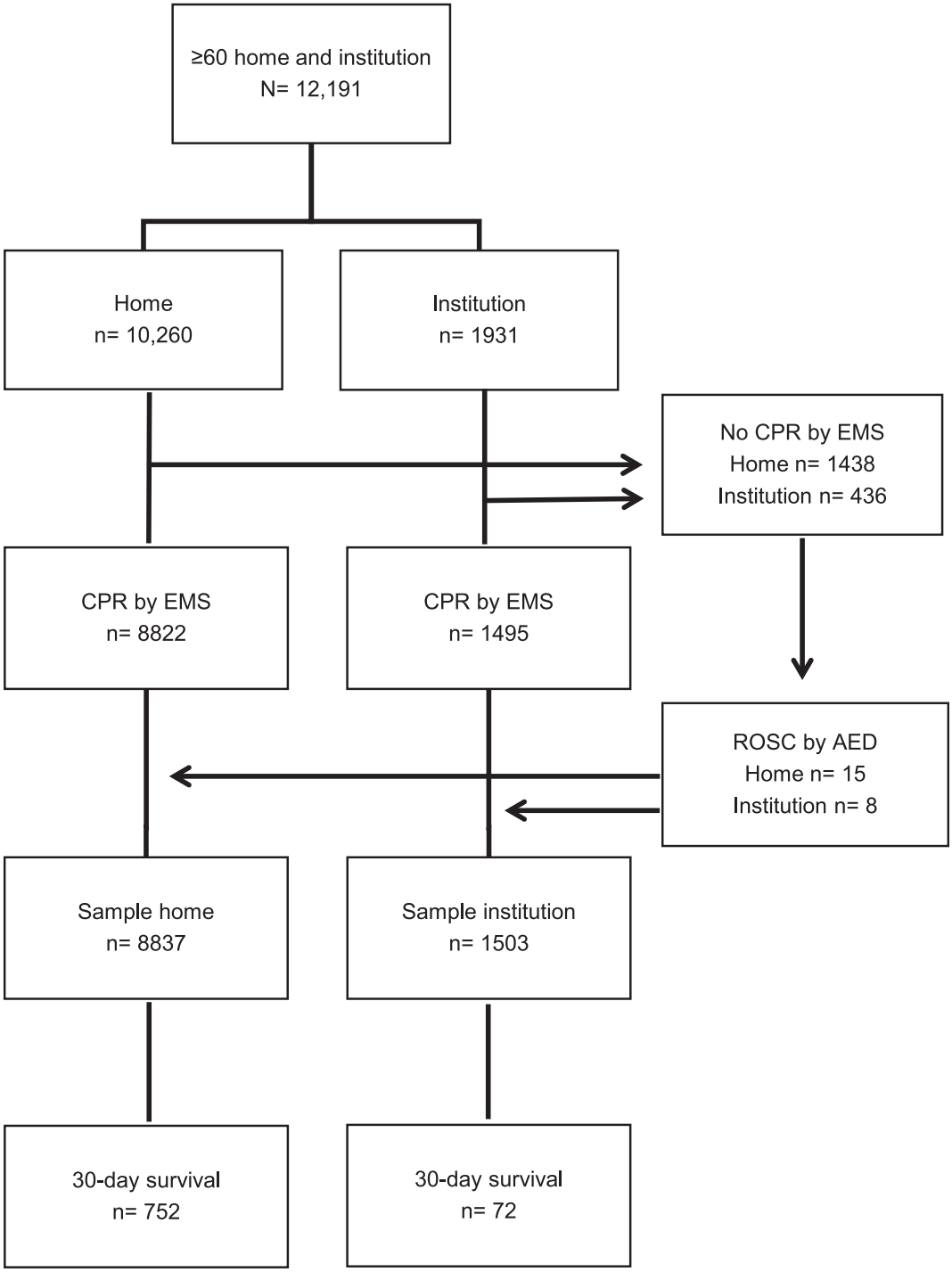


**Fig. 1 – Flow diagram of the study population. AED: Automatic external defibrillator, CPR: cardiopulmonary resuscitation, EMS: Emergency medical service, ROSC: Return of spontaneous circulation, ROSC by AED: patients who sustained ROSC by a shock from an AED before EMS arrival.**

collapse. In the adjusted analysis, suffering cardiac arrest at home was not associated with improved survival compared to healthcare institutions (Table 3).

Among the 30-day survivors, CPC was recorded in 694 patients of whom 611 (88%) patients were discharged with CPC $\leq$ 2. (Fig. 2) All 30-day survivors aged 90 years or over, where CPC was reported, had CPC $\leq$ 2.

There were significant differences in the rates of withholding and withdrawing CPR in healthcare institutions and at home (Table 4). A total of 1874 cases received CPR by bystanders, but the EMS did not continue treatment. Nearly one thousand (937, 7.7%) of them were alive at arrival of EMS and were thus not resuscitated by EMS even if CPR had been provided by bystanders, including 23 patients that achieved ROSC by AED before EMS arrival. As seen in Table 4, futil-

**Table 1 – Demographics and characteristics of resuscitation attempts in age cohorts.**

| | Home | | | | | Institution | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variables, n (%) | 60–69 | 70–79 | 80–89 | 90+ | Total | 60–69 | 70–79 | 80–89 | 90+ | Total |
| n | 2910 | 3880 | 2755 | 715 | 10,260 | 283 | 522 | 755 | 371 | 1931 |
| Mean age (SD) | | | | | 76 (9) | | | | | 81 (9) |
| Females | 945 (32) | 1288 (33) | 1063 (39) | 377 (53) | 3673 (36) | 100 (35) | 236 (45) | 412 (55) | 237 (64) | 985 (51) |
| Witnessed total | 1672 (57) | 2326 (60) | 1678 (61) | 391 (55) | 6067 (59) | 169 (60) | 377 (72) | 573 (76) | 272 (73) | 1391 (72) |
| Witnessed bystander | 1437 (49) | 1977 (51) | 1386 (50) | 326 (46) | 5126 (50) | 155 (55) | 324 (62) | 500 (66) | 227 (61) | 1206 (62) |
| Witnessed by EMS | 235 (8) | 349 (9) | 292 (11) | 65 (9) | 941 (9) | 14 (4.9) | 53 (10) | 73 (9.7) | 45 (12) | 185 (9.6) |
| Bystander CPR* | 2151 (80) | 2687 (76) | 1847 (75) | 523 (80) | 7208 (77) | 249 (93) | 435 (93) | 638 (94) | 295 (90) | 1617 (93) |
| Initial rhythm VT/VF | 606 (2) | 662 (19) | 390 (17) | 72 (12) | 1730 (20) | 25 (11) | 48 (12) | 62 (10) | 17 (6) | 152 (10) |
| EMS treated or ROSC by AED | 2498 (86) | 3396 (88) | 2363 (86) | 580 (81) | 8837 (86) | 226 (80) | 410 (79) | 594 (79) | 273 (74) | 1503 (78) |

AED: Automatic external defibrillator, CPR: cardiopulmonary resuscitation, EMS: Emergency medical service, OHCA: Out of hospital cardiac arrest, ROSC: Return of spontaneous circulation, VT/VF: pulseless ventricular tachycardia/ventricular fibrillation. * EMS witnessed excluded in (%).

**Table 2 – Survival and neurological outcome if given CPR by EMS or ROSC by AED (n = 10,340).**

| | Home | | | | | Institution | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age cohort | 60–69 | 70–79 | 80–89 | 90+ | Total | 60–69 | 70–79 | 80–89 | 90+ | Total |
| n | 2498 | 3396 | 2363 | 580 | 8837 | 226 | 410 | 594 | 273 | 1503 |
| Sustained ROSC, n (%) | 708 (28) | 795 (23) | 436 (19) | 73 (13) | 2012 (23) | 72 (32) | 101 (25) | 104 (18) | 34 (13) | 311 (21) |
| Transported to hospital*, n (%) | 848 (34) | 987 (29) | 541 (23) | 84 (14) | 2451 (28) | 85 (38) | 123 (30) | 120 (20) | 40 (15) | 368 (24) |
| Alive after 24 hours, n (%) | 587 (23) | 545 (16) | 253 (11) | 30 (5.2) | 1415 (16) | 56 (25) | 53 (13) | 49 (8.2) | 15 (5.5) | 173 (12) |
| Alive after 30 days, n (%) | 344 (14) | 279 (8.2) | 114 (4.8) | 15 (2.6) | 752 (8.5) | 22 (9.7) | 26 (6.3) | 22 (3.7) | 2 (0.7) | 72 (4.8) |
| Alive after 1 year, n (%) | 319 (13) | 230 (6.8) | 87 (3.7) | 10 (1.7) | 646 (7.3) | 18 (8) | 20 (4.9) | 17 (2.9) | 2 (0.7) | 57 (3.8) |

AED: Automatic external defibrillator, CPR: cardiopulmonary resuscitation, EMS: Emergency medical service, ROSC: Return of spontaneous circulation.
* Includes patients transported with ongoing CPR and patients that are dead on arrival to hospital.

ity was the most common reason for EMS withholding CPR ($n$ = 639). The most common cause for termination of resuscitation was that no ROSC was obtained. The most cited reason for withdrawal of resuscitation was medical history ($n$ = 1251).

## Discussion

In this study, we included 12,191 patients 60 years and older that received resuscitation attempt from either bystander or EMS in healthcare institutions or at home. EMS started or continued resuscitation in 85% of the patients. When EMS confirmed cardiac arrest, the most frequent reason for not starting CPR was that resuscitation was perceived as futile.

### *Survival regardless of age and place of arrest*

The decision to resuscitate is often based on directly available information like age, place of arrest, initial rhythm, witnessed status and bystander CPR, all factors known to impact survival and outcome.[11–12,20–22] Perceptions about the expected outcome for elderly patients suffering OHCA may also influence the decision to start CPR or not.[13].

The average life expectancy for nursing home residents in Norway is 2 years from admission[23], and according to NorCAR, 11 % of OHCA occurs in healthcare institutions[24]. Previous studies report no survivors in nursing homes,[13,20,25] significantly lower survival between home and healthcare institutions,[11,14,26] and similar survival when resuscitation is initiated[21] or when adjusted for known prognostic factors.[1] We also found OHCA in healthcare institutions to be more frequently witnessed and to have a higher rate of CPR before EMS arrival. Despite this, the overall survival rate is significantly lower in healthcare institutions Table 2. We can only speculate that the observed difference partly could be explained by frailty before the cardiac arrest and higher number of co-morbidities in the patients in healthcare institutions, but these factors are not available in our registry. However, when adjusting for some well-known OHCA characteristics or when comparing survival per 100,000 capita the survival was not different.

Regardless of the place of arrest, we found survivors in all age cohorts, adding to the findings of others that age alone is a poor predictor for survival.[5,22,25,26] In addition, half of the patients alive more than 24 hours after the cardiac arrest survived to 30 days, and most 30-day survivors lived past one year.

**Table 3 – Multivariate analysis examining factors related to 30-day survival for EMS-treated or ROSC by AED.**

| | Univariate (n = 10,340) | | | | Multivariate (n = 8233*) | | | |
|---|---|---|---|---|---|---|---|---|
| **Covariate** | **OR unadjusted** | **p-value** | **95% CI** | | **OR adjusted** | **p-value** | **95%CI** | |
| OHCA at home | 1.85 | <0.001 | 1.44 | 2.37 | 1.16 | 0.37 | 0.85 | 1.58 |
| Female | 0.54 | <0.001 | 0.46 | 0.64 | 0.76 | 0.01 | 0.61 | 0.94 |
| AED attached | 0.75 | 0.02 | 0.59 | 0.96 | 1.43 | 0.02 | 1.07 | 1.91 |
| Presumed cardiac aetiology | 1.28 | 0.007 | 1.07 | 1.53 | 0.74 | 0.02 | 0.573 | 0.95 |
| Age (years) | | | | | | | | |
| 60–69 | Ref. cat. | | | | Ref. cat. | | | |
| 70–79 | 0.56 | <0.001 | 0.48 | 0.66 | 0.54 | <0.001 | 0.44 | 0.66 |
| 80–89 | 0.31 | <0.001 | 0.25 | 0.38 | 0.29 | <0.001 | 0.23 | 0.38 |
| 90+ | 0.13 | <0.001 | 0.08 | 0.21 | 0.07 | <0.001 | 0.03 | 0.17 |
| Bystander CPR before EMS arrival*,** | 1.41 | 0.002 | 1.13 | 1.76 | 1.21 | 0.12 | 0.95 | 1.54 |
| Witnessed | 6.3 | <0.001 | 4.95 | 8.04 | 3.6 | <0.001 | 2.78 | 4.70 |
| Initial VT/VF | 9.08 | <0.001 | 7.81 | 10.56 | 6.04 | <0.001 | 4.93 | 7.39 |
| EMS response interval under 9 min | 1.22 | 0.007 | 1.05 | 1.40 | 1.84 | <0.001 | 1.52 | 2.24 |

AED: Automatic external defibrillator, CPR: cardio-pulmonary resuscitation, EMS: Emergency medical services, OHCA: out-of-hospital cardiac arrest, Ref. cat: Reference category, VT/VF: Pulseless ventricular tachycardia/ ventricular fibrillation.

* EMS witnessed excluded, n = 9002.

** Those who only received CPR by a first responder are coded as "no bystander CPR".

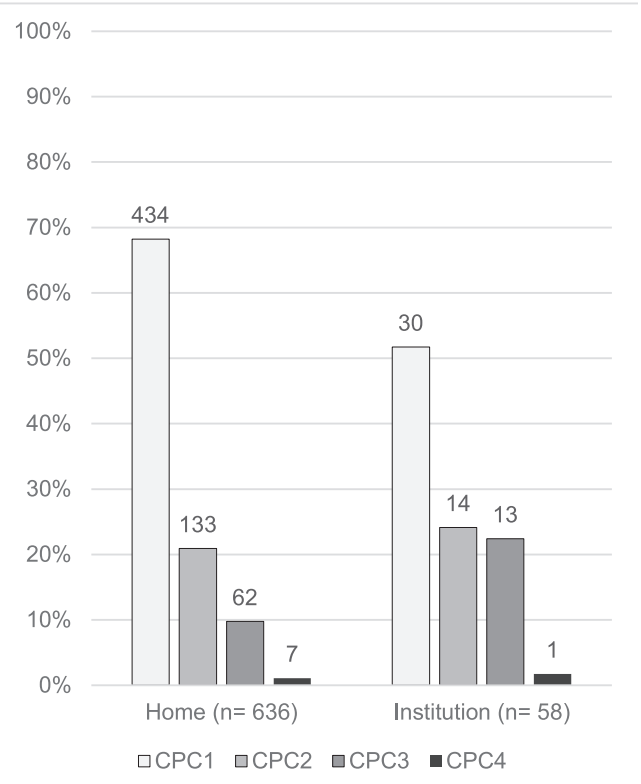


**Fig. 2 – Cerebral Performance Category (CPC) in 30-day survivors, according to the place of arrest (n = 694*). The Y-axis represents the percentage of survivors where CPC was reported. Above each column is the number of survivors with the corresponding CPC score. *CPC was not reported in 130 of 824 (16%) of the 30-day survivors.**

Successful resuscitation is measured as both survival and a good neurological outcome.[2,12,27] CPC was missing in 16% of the survivors, and we do not know if there is an overrepresentation of patients with low CPC scores in the missing group. Neither do we know if the registered CPC represents a deterioration or return to pre-morbid state as we do not have pre-arrest CPC in our registry. When CPC was reported, most of the patients surviving 30 days had a good neurological outcome. We found that a CPC of 4 was reported for 1.2% of our survivors only, and all survivors over 90 years had a CPC of $\leq$ 2, confirming that most of the elderly who survive have a favourable neurologic outcome. There is, therefore, an unfounded belief that most elderly patients will be resuscitated to a vegetative or unfavourable neurological state.[2,4,5,22,26].

Moreover, survival and outcome depends on many external variables including a nations EMS structure, governmental and societal factors. Norway is known for the high willingness to perform bystander CPR.[15,19] This may not only impact the survival rate, but it may also contribute to why 88% of the survivors had a good outcome. In a recent study comparing Norway and Germany, incidence of and survival after OHCA was similar, but more patients were treated by EMS and admitted to hospital in the German population.[19].

### *The "unlikely" survivors*

A Finnish study found no survivors if the OHCA occurred in a primary care facility when the first rhythm was non-shockable[25], and the REPROPRIATE study[13] reports no survivors if the patient were 80 years or older and the arrest was unwitnessed and the first rhythm was non-shockable. In our study, we found 324 survivors in the non-shockable group, regardless of the place of arrest, 48 of whom were unwitnessed. If older adults presenting with a non-shockable rhythm are frequently exempted from resuscitation attempts, or resuscitation is withdrawn early, this will result in a self-fulfilling prophecy of no survivors in this group.

**Table 4 – Stated reasons for withholding or withdrawing EMS resuscitation for patients with OHCA at home or in healthcare institutions.**

| | **Home** n (%) | **Institution** n (%) | p-value |
|---|---|---|---|
| **Withhold*** n = 1874 | 1438 | 436 | <0.001 |
| No arrest/alive** | 706 (49) | 231 (53) | 0.15 |
| Futile | 573 (40) | 66 (15) | <0.001 |
| Medical history | 86 (6) | 47 (11) | 0.001 |
| DNAR | 34 (2.3) | 70 (16) | <0.001 |
| Unknown | 39 (2.7) | 22 (5) | 0.016 |
| **Withdrawn** n = 7974 | 6789 | 1185 | <0.001 |
| No ROSC | 4466 (66) | 577 (49) | <0.001 |
| Medical history | 955 (14) | 296 (25) | <0.001 |
| DNAR | 88 (1.3) | 127 (11) | <0.001 |
| Other | 662 (9.8) | 82 (6.9) | 0.002 |
| Unknown | 618 (9.1) | 103 (8.7) | 0.65 |

EMS: Emergency medical services, CPR: cardio-pulmonary resuscitation, DNAR: do not resuscitate orders, ROSC: the return of spontaneous circulation.

* All received bystander CPR.

** Includes 23 cases of ROSC by AED before EMS arrival.

***Withholding or withdrawing resuscitation***

EMS personnel more often withheld resuscitation because resuscitation was considered futile for patients suffering OHCA at home compared to healthcare institutions. Patients in healthcare institutions had a higher proportion of witnessed arrests and more often received CPR before EMS arrival, which is associated with higher survival and better neurological outcomes.[2,27] High rates of bystander CPR in healthcare institutions may lead to inappropriately high numbers of resuscitation attempts by EMS, that in turn will reduce the survival rates.

Many Norwegian nurses report being unaware that they legally can refrain from CPR if they perceive it to be futile, and some report using "slow codes", where they might provide sub-optimal CPR in wait for others.[3] We observed a high rate of bystander CPR in health care institutions and yet many cases of EMS withdrawing CPR due to medical history. We can only speculate that this may be a similar expression of uncertainty among personnel in healthcare institutions, and a wish for a second opinion regarding the decision to continue resuscitation.

A holistic approach to clinical judgment, evaluating the cause of arrest and current life situation, in addition to objective factors, may reduce the harm inflicted by excessive resuscitation attempts.[8,20] Unnecessary CPR may harm patients' dignity and rights to a peaceful end of life, and it also affects healthcare personnel. Nurses that feel obliged to take part in unnecessary or harmful procedures feel troubled.[3] Nearly one-fifth of patients in healthcare institutions had resuscitation terminated due to futility or medical history, indicating that more patients could benefit from treatment directives. The conversation between treating physician, patients, and next of kin regarding treatment directives, must be initiated sooner rather than later, as three out of ten elderly dies within their first six months in nursing homes in Norway.[23] Moreover, when the patient deteriorates, it is less likely the patient is able to partake in, and consent to, decisions about advanced treatment directives.[28] When more patients have documented plans for their end-of-life care, it will limit the need for sudden decisions on whether to start CPR or not.[6,29] Ultimately, this should lead to a lower number of patients where EMS personnel do not continue, or quickly terminate, resuscitation.

We found that almost 9% of the patients with cardiac arrest in healthcare institutions had resuscitation terminated due to a DNAR order. Adding to several studies discovering that some patients with DNAR orders still receive resuscitation.[13,25,30–32] A delay in, or lack of DNAR information being provided to EMS has already been shown in previous studies[7,25,30]. Most resuscitation attempts are stopped when a DNAR is presented, but with the current practise to store the documentation locally, it can take a while to retrieve. A study found that in those instances where resuscitation was continued despite a DNAR order, the cardiac arrest was more often witnessed and there was a shockable rhythm, and half had achieved ROSC by the time the DNAR directive was available.[30] Other reasons for starting CPR, even if there is a DNAR order, were; a lack of written directives, the present family not accepting the DNAR[8], or the family possibly being unaware or poorly informed.[28,31,32] However, unlike previous studies from England[31] and France[32], we found that the majority of patients with DNAR that still received CPR, were in healthcare institutions.

## Limitations

The NorCAR registry cannot retrospectively inspect whether a DNAR order was present but unknown to the EMS. Thus, the number may be higher than reported in both locations. We advocate that these challenges regarding DNAR orders can be solved by making them electronically available for the EMS.[33]

All data included in this study were collected in NorCAR for quality improvement. The method for determining CPC in the registry has not been validated. It is therefore only used descriptively and is not included in the regression. In this study, we could not collect pre-arrest information, such as CPC prior to cardiac arrest, co-morbidities or frailty, as this information is not available in the registry. A recent NorCar study, of all ages and locations, found that a substantial proportion (91%) of the OHCA patients had one or more pre-existing conditions, where cardiovascular diseases were the most common (85%).[34] Another previous study has shown that the completeness for NorCAR is high, indicating that data in the registry is representable for all patients in Norway that receive CPR.[35]

The study period includes years before and during the COVID-19 pandemic, which affected total mortality in many countries. In Nor-CAR the incidence of cardiac arrest, presumed cause of arrest, and survival rates remained stable during these years.[36,37] In our subset of cases in healthcare institutions, we found no differences before or during the pandemic (data not shown).

## Conclusion

This study adds updated evidence for the expected outcome for the elderly suffering an out-of-hospital cardiac arrest and confirms that older age alone poorly predicts survival. We found that the EMS frequently do not attempt or withdraw resuscitation in healthcare institutions due to factors that could have been foreseen.

Survival in healthcare institutions and at home is similar when adjusted for incidence, and fear of unfavourable neurological outcomes amongst the elderly should not prevent resuscitation attempts. This must be communicated to healthcare professionals to support them, their patients and their families in decision-making when discussing treatment directives.

## CRediT authorship contribution statement

**Astrid Karina V. Harring:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization. **Jo Kramer-Johansen:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization. **Ingvild B.M. Tjelmeland:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization, Project administration.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

This study would not be possible without the diligent local data managers and our great colleagues in the EMS, who consistently provide high-quality patient care.

## Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resuscitation.2023.109871.

## Author details

[a]*Oslo Metropolitan University, Oslo, Norway*[b]*Division of Prehospital Services, Oslo University Hospital, Oslo, Norway* [c]*Faculty of Medicine, Institute of Clinical Medicine, University of Oslo, Oslo, Norway*

## REFERENCES

1. Søholm H, Bro-Jeppesen J, Lippert FK, et al. Resuscitation of patients suffering from sudden cardiac arrests in nursing homes is not futile. Resuscitation 2014;85:369–75.
2. Hirlekar G, Karlsson T, Aune S, et al. Survival and neurological outcome in the elderly after in-hospital cardiac arrest. Resuscitation 2017;118:101–6.
3. Saevareid TJ, Balandin S. Nurses' perceptions of attempting cardiopulmonary resuscitation on oldest old patients. (Report). J Adv Nursing 2011;67:1739.
4. Winther-Jensen M, Kjaergaard J, Hassager C, et al. Resuscitation and post resuscitation care of the very old after out-of-hospital cardiac arrest is worthwhile. Int J Cardiol. 2015;201:616–23.
5. Hiemstra B, Bergman R, Absalom AR, et al. Long-term outcome of elderly out-of-hospital cardiac arrest survivors as compared with their younger counterparts and the general population. Ther Adv Cardiovasc Dis. 2018;12:341–9.
6. Tanner R, Masterson S, Jensen M, et al. Out-of-hospital cardiac arrests in the older population in Ireland. Emerg Med J. 2017;34:659–64.
7. Rolfsjord I, Mdala I, Straand J. Doctor's visits to nursing homes: Are out-of-hours doctors given sufficient patient information? Sykepleien forskning (Oslo) 2019:e-75498.
8. Brandling J, Kirby K, Black S, Voss S, Benger J. Emergency medical service provider decision-making in out of hospital cardiac arrest: an exploratory study. BMC Emerg Med. 2017;17:24 -.
9. Mentzelopoulos SD, Couper K, Voorde PV, et al. Ethics of resuscitation and end of life decisions. Resuscitation. 2021;2021:408–32.
10. May TL, Ruthazer R, Riker RR, et al. Early withdrawal of life support after resuscitation from cardiac arrest is common and may result in additional deaths. Resuscitation 2019;139:308–13.
11. Pape M, Rajan S, Hansen SM, et al. Survival after out-of-hospital cardiac arrest in nursing homes – A nationwide study. Resuscitation 2018;125:90–8.
12. Einav S, Cortegiani A, Marcus EL. Cardiac arrest in older adult patients. Curr Opin Anaesthesiol. 2021;34:40–7.
13. Druwé P, Benoit DD, Monsieurs KG, et al. Cardiopulmonary resuscitation in adults over 80: outcome and the perception of appropriateness by clinicians. J Am Geriatr Soc. 2020;68:39–45.
14. Deasy C, Bray JE, Smith K, et al. Resuscitation of out-of-hospital cardiac arrests in residential aged care facilities in Melbourne. Australia. Resuscitation 2012;83:58–62.
15. Tjelmeland IBM, Alm-Kruse K, Andersson L-J, et al. Cardiac arrest as a reportable condition: a cohort study of the first 6 years of the Norwegian out-of-hospital cardiac arrest registry. BMJ open 2020;10 e038133.
16. Jacobs I, Nadkarni V, Bahr J, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: update and simplification of the Utstein templates for resuscitation registries.: a statement for healthcare professionals from a task force of the international liaison committee on resuscitation (American Heart Association, European Resuscitation Council, Australian Resuscitation Council, New Zealand Resuscitation Council, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa). Resuscitation 2004;63:233–49.
17. SSB. 07459: Population. Statbank: Statistics Norway; 2023. https://www.ssb.no/statbank/table/07459/.
18. SSB. 11875: Health and care institutions. Statbank: Statistics Norway; 2023. https://www.ssb.no/statbank/table/11875.
19. Tjelmeland IBM, Alm-Kruse K, Grasner J-T, et al. Importance of reporting survival as incidence: a cross-sectional comparative study on out-of-hospital cardiac arrest registry data from Germany and Norway. BMJ Open 2022;12:e058381 -e.

20. Druwé P, Monsieurs KG, Piers R, et al. Perception of inappropriate cardiopulmonary resuscitation by clinicians working in emergency departments and ambulance services: The REAPPROPRIATE international, multi-centre, cross sectional survey. Resuscitation 2018;132:112–9.
21. Vaux J, Lecarpentier E, Heidet M, et al. Management and outcomes of cardiac arrests at nursing homes: a French nationwide cohort study. Resuscitation 2019;140:86–92.
22. Libungan B, Lindqvist J, Strömsöe A, et al. Out-of-hospital cardiac arrest in the elderly: a large-scale population-based study. Resuscitation 2015;94:28–32.
23. The Norwegian Directorate of Health. Botid i sykehjem og varighet av tjenester til hjemmeboende (Length of stay in a nursing home and duration of services for home residents); 2017. https://www.helsedirektoratet.no/rapporter/botid-i-sykehjem-og-varighet-av-tjenester-til-hjemmeboende/2017-02%20Botid%20i%20sykehjem%20og%20varighet%20av%20tjenester%20til%20hjemmeboende.pdf.
24. Norwegian Cardiac Arrest Registry, Årsrapport for 2018 med plan for forbedringstiltak (Annual report for 2018 with plan for improvement measures). 2018: Medisinske kvalitetsregistre (Medical Quality Registries). https://www.kvalitetsregistre.no/sites/default/files/7_arsrapport_2018_norsk_hjertestansregister_1.pdf.
25. Kangasniemi H, Setälä P, Huhtala H, et al. Out-of-hospital cardiac arrests in nursing homes and primary care facilities in Pirkanmaa, Finland. Acta anaesthesiologica Scandinavica 2018;62:1297.
26. Andrew E, Mercier E, Nehme Z, Bernard S, Smith K. Long-term functional recovery and health-related quality of life of elderly out-of-hospital cardiac arrest survivors. Resuscitation 2018;126:118–24.
27. Seewald S, Wnent J, Lefering R, et al. CaRdiac Arrest Survival Score (CRASS) — A tool to predict good neurological outcome after out-of-hospital cardiac arrest. Resuscitation 2020;146:66–73.
28. Bremer A, Årestedt K, Rosengren E, Carlsson J, Sandboge S. Do-not-attempt-resuscitation orders: attitudes, perceptions and practices of Swedish physicians and nurses. BMC Med Ethics 2021;22:34.
29. Sævareid TJL, Lillemoen L, Thoresen L, Førde R, Gjerberg E, Pedersen R. Implementing advance care planning in nursing homes - study protocol of a cluster-randomized clinical trial. BMC Geriatr. 2018;18:180.
30. Counts CR, Blackwood J, Winchell R, et al. Emergency Medical Services and Do Not Attempt Resuscitation directives among patients with out-of-hospital cardiac arrest. Resuscitation 2021;158:73–8.
31. Barnard EBG, Sandbach DD, Nicholls T, Wilson A, Ercole A. Resuscitation of patients with active Do Not Attempt Cardiopulmonary Resuscitation (DNACPR) status after out-of-hospital cardiac arrest. Resuscitation 2019;142:23–4.
32. Reuter P-G, Agostinucci J-M, Bertrand P, Gonzalez G, De Stefano C, Hennequin B, et al. Prevalence of advance directives and impact on advanced life support in out-of-hospital cardiac arrest victims. Resuscitation 2017;116:105–8.
33. Harring AKV, Tjelmeland IB, Andenæs R, Kramer-Johansen J. Blir beslutninger om behandlingsbegrensninger respektert utenfor sykehus når man har ringt 113? Tidsskrift for omsorgsforskning 2022;8:1–13.
34. Alm-Kruse K, Tjelmeland I, Reiner A, Kvåle R, Kramer-Johansen J. Use of healthcare services before and after out-of-hospital cardiac arrest. Resuscitation 2023;187 109805.
35. Alm-Kruse K, Tjelmeland I, Kongsgård H, Kvåle R, Kramer-Johansen J. Case completeness in the Norwegian Cardiac Arrest Registry. Resuscitation plus 2021;8 100182.
36. Tjelmeland IBM, Wnent J, Masterson S, et al. Did lockdown influence bystanders' willingness to perform cardiopulmonary resuscitation? A worldwide registry-based perspective. Resuscitation 2023;186 109764.
37. Tjelmeland I, Kramer-Johansen J, Nilsen JE, et al. Norsk hjertestansregister: Et register over personer i Norge som er forsøkt gjenopplivet. Årsrapport for 2021 med plan for forbedringstiltak. (Norwegian Cardiac Arrest Registry: Annual report for 2021 with plan for improvement measures). https://www.kvalitetsregistre.no/sites/default/files/2022-06/Årsrapport%202021%20Norsk%20hjertestansregister.pdf.