

Clinical resuscitation management of non-traumatic out-of-hospital cardiac arrests (OHCA) in Swiss emergency centres: a survey study

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Summary

INTRODUCTION: Optimising cardiopulmonary resuscitation (CPR) management is crucial for out-of-hospital cardiac arrest (OHCA) survival but requires a clear understanding of the entire chain of survival. However, detailed OHCA management data from Swiss emergency centres (EC) are limited.

METHODS: A nationwide cross-sectional survey was conducted among Level 1 and 2 ECs affiliated with the Swiss Society of Emergency and Rescue Medicine (SGNOR). The questionnaire covered key aspects of CPR management, including EC characteristics, team composition, resuscitation protocols and challenges pertaining to the year 2022. Analyses were performed using descriptive methods.

RESULTS: Response rates were 94% (15/16) from Level 1 and 28% (10/36) from Level 2 ECs. CPR training is widely implemented with 90% of centres conducting emergency bay simulations. ACLS certification is mandated in 73% of Level 1 but only 20% of Level 2 centres. Team composition and debriefing practices vary with a structured debriefing absent in 67%/60% of Level 1/2 ECs. Mechanical chest compression devices are used in 80%/30% of ECs, while extracorporeal membrane oxygenation is available in 73%/10% ECs. Standard operating procedures are widely implemented, but 40%/60% of ECs lack structured OHCA databases. Challenges differ by Level, with Level 1 centres reporting variability in expertise due to frequently rotating staff and Level 2 centres highlighting staff shortages especially during night shifts. Decision-making challenges include termination of resuscitation, interdisciplinary coordination and post-resuscitation care. Research engagement is limited to 20% of Level 1 centres, but 93% of Level 1 and 50% of Level 2 ECs report willingness to engage in research projects under specific conditions, such as minimal time commitment.

CONCLUSION: Significant variability in CPR management, training and data collection exists across Swiss ECs. Standardised protocols, structured training and improved interdisciplinarity coordination are needed. Enhancing data registration and aligning practices with international guidelines could optimise patient outcomes, emphasising the need for further research and national standardisation efforts.

Introduction

Effective cardiopulmonary resuscitation (CPR) management is essential for the survival of out-of-hospital cardiac arrest (OHCA) patients as optimising resuscitation quality complements prevention strategies to reduce mortality [1]. The *chain of survival*, particularly the clinical aspects of CPR management, represents the most actionable area for improving survival rates with favourable neurological outcomes [2]. The Utstein formula of survival with its three components (1) *educational efficiency*, (2) *medical science* and (3) *local implementation* builds the foundation of research in CPR management [3].

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Educational efficiency is critical for improving survival rates among patients experiencing OHCA. The American Heart Association (AHA) guidelines on CPR and emergency cardiovascular care highlight the importance of effective training in enhancing both provider performance and patient outcomes [4]. In the European context, ACLS certification generally refers to the Advanced Life Support (ALS) certification provided by the European Resuscitation Council (ERC) [5] rather than the American Heart Association (AHA) ACLS programme [6]. As a foundational step, it is necessary to conduct an evaluation of the training resources and methodologies employed across Swiss emergency centres. Such an analysis would facilitate the identification of existing gaps and inform the development of standardised, evidence-based training protocols.

The quality assurance of CPR management is enhanced through advancements in *medical science* such as technical procedures like extracorporeal membrane oxygenation (ECMO) [7–10] or vector-change defibrillation [11]. However, a systematic evaluation of current practices in Switzerland and their alignment with the latest evidence has yet to be conducted. Furthermore, the interplay between individual elements of CPR management remains underexplored.

To generate solid data on CPR management and increase knowledge about *local implementation*, continuous measurement of resuscitation quality and patient outcomes is required [2].

Currently there is a prehospital resuscitation data registry in Switzerland: SWISSRECA. All emergency medical services (EMS) are obliged to enter their data into the SWISSRECA data registry. However, in-hospital and follow-up data remain incomplete, since data registration is not mandatory for Swiss emergency centres [12]. It is therefore crucial to evaluate their current registration methods and identify opportunities for standardisation and implementation of locally tailored resuscitation guidelines.

To address the identified knowledge gaps in the three components of the Utstein formula of survival, we conducted a nationwide survey on CPR management in Swiss level 1 [13] and 2 [14] emergency centres.

Methods

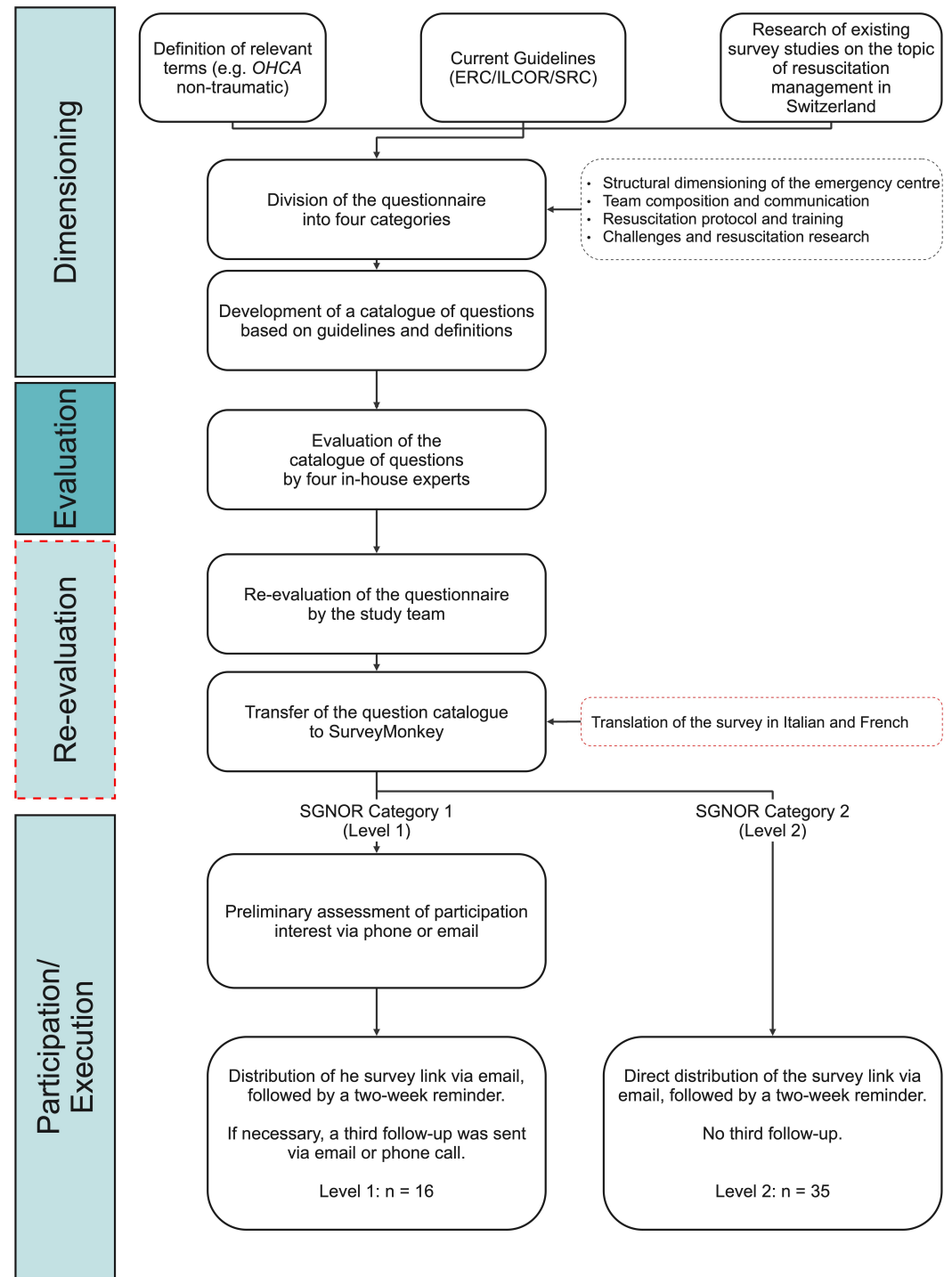
Survey development

This web-based cross-sectional survey incorporates all three factors of the Utstein formula for survival and was developed according to the CROSS reporting criteria [15]. It underwent a single round of Delphi consultation with an expert panel from the Department of Emergency Medicine at Bern University Hospital, Inselspital, in Bern, Switzerland. Experts were selected based on clinical experience in resuscitation, emergency medicine and medical education. Panel members reviewed the draft survey for relevance, clarity and completeness. Final modifications were made according to their consensus feedback. The complete process of survey development is shown in figure 1. The emergency medical services (EMS) system in Switzerland is comprehensively documented through the SWISSRECA registry. Consequently, this survey study prioritises the investigation of intra-hospital management strategies for OHCA patients, excluding EMS data from its scope.

ABBREVIATIONS

ACLS	Advanced Cardiac Life Support
AHA	American Heart Association
BLS	Basic Life Support
CPR	CPR: Cardio-Pulmonary Resuscitation
CRM	Crisis Resource Management
ECMO	Extra-Corporeal Membrane Oxygenation
ERC	European Resuscitation Council
ILCOR	International Liaison Committee on Resuscitation
OHCA	Out-of-Hospital Cardiac Arrest
ROSC	Return Of Spontaneous Circulation
SGNOR	Schweizerische Gesellschaft für Notfall- und Rettungsmedizin (Swiss Society for Emergency and Rescue Medicine)
SOP	Standard Operating Procedure
SRC	Swiss Resuscitation Council

Figure 1: Development of the clinical resuscitation management survey.



Persons involved:

- UKN*- survey team
Dr. med. Sabrina Lanz, Prof. Dr. med. Martin Müller, Luisa Steiner
- UKN*- expert panel
Prof. Dr. med. Wolf Hautz, Prof. Dr. med. Thomas Sauter, Dr. med. Stephan Ziegenhorn
- UKN*- survey team
In collaboration with translators working at the UKN (Dr. med. Elisa Ferrazzini, Alexandre Anthanasios Musy)

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The CPR survey comprised 27 questions organised into four categories and referred to the year 2022: i) characteristics of the emergency centre, ii) team and communication, iii) CPR protocol and training, and iv) challenges and resuscitation research. The survey included questions on ACLS certification requirements to assess standardisation across emergency centres. To capture all different certification practices, the survey included an open answer field for respondents to specify other requirements beyond formal ACLS/ALS certification. This distinction is important when interpreting survey results, as terminology varies between regions. The full survey is shown in appendix 1.

The survey was translated into the three most spoken national languages in Switzerland – German, French and Italian [16] – allowing each representative to choose their preferred language when completing it.

Survey participants

For this study, Swiss Society for Emergency and Rescue Medicine (SGNOR) category 1 (n = 16) and 2 (n = 35) training centres were defined as level 1 and level 2 emergency centres, respectively, and the survey was completed by representatives from each centre. Requirements for an SGNOR category 1 emergency training centre comprise 24-hour availability of anaesthesiology, bronchoscopy, interventional radiology and cardiology services as well as stroke centre certification. In contrast, SGNOR category 2 emergency training centres are required to provide extended standard emergency care, including intensive and intermediate care units, but do not offer the specialised treatment options available in category 1 centres [17]. Level 1 emergency centres were selected assuming a high rate of allocation of OHCA cases related to the availability of labour resources and advanced treatment options. Additionally, level 2 emergency centres were included in the survey to reflect broader clinical practice and establish a comparison of CPR management.

Data collection and measurements

The survey was sent to all level 1 and level 2 emergency centres via e-mail, containing the survey link through SurveyMonkey, followed by a two-week reminder. For level 1 centres, a preliminary assessment of participation interest was conducted via phone or e-mail before distributing the survey. If necessary, a third follow-up was sent to level 1 centres via e-mail or phone to increase the response rate. Each emergency centre designated one doctor to complete the survey by retrieving the hospital's internal data. However, no additional details about the respondents, such as their level of training or professional experience, were collected.

Open science and protocol transparency

This study followed open-science principles for survey research. As it was a descriptive nationwide survey without patient-level data, no formal registration in a public registry was required. The complete questionnaire, including all survey items, is provided in appendix 1. No protocol deviations occurred during the study.

Statistical analysis

Given the limited number of participating centres, the survey was analysed descriptively, without conducting inferential statistical analyses. Quantitative responses are presented as means, with standard deviations (SD) provided in brackets. Variables with skewed distributions (e.g. number of OHCA cases per year) are reported as medians with interquartile ranges (IQR). Figures were created using Stata/MP 18.0 for Mac (Apple Silicon). The map of Switzerland was generated using the *geoplot* command [18], with geographical data sourced from the Swiss Federal Statistical Office [19].

Ethics statement

The study was performed in accordance with Swiss law. There was no need for an ethical review for this survey study.

Results

Infrastructure, resources and research

Emergency centre characteristics and infrastructure

The survey response rate was 94% (15/16) for level 1 and 28% (10/36) for level 2 emergency centres. Table 1 summarises the structural and organisational characteristics of the participating emergency centres. Level 1 centres reported a mean of 31.6 (SD: 9.7) treatment bays compared to 14.3 (SD: 6.0) in level 2 centres. The annual patient volume was more than twice as high in Level 1 centres. Data availability and quality varied considerably, with 40% of Level 1 and 60% of Level 2 centres lacking a structured OHCA database. Research activity was reported in 20% of Level 1 centres, while 93% of them expressed interest in future collaboration (table 1).

Table 1: OHCA management infrastructure and research activity in Swiss emergency centres. Percentages refer to all responding centres within each level (Level 1, n = 15; Level 2, n = 10). Variables with skewed distributions (annual OHCA cases and patients arriving under ongoing CPR) are presented as median with interquartile range (IQR).

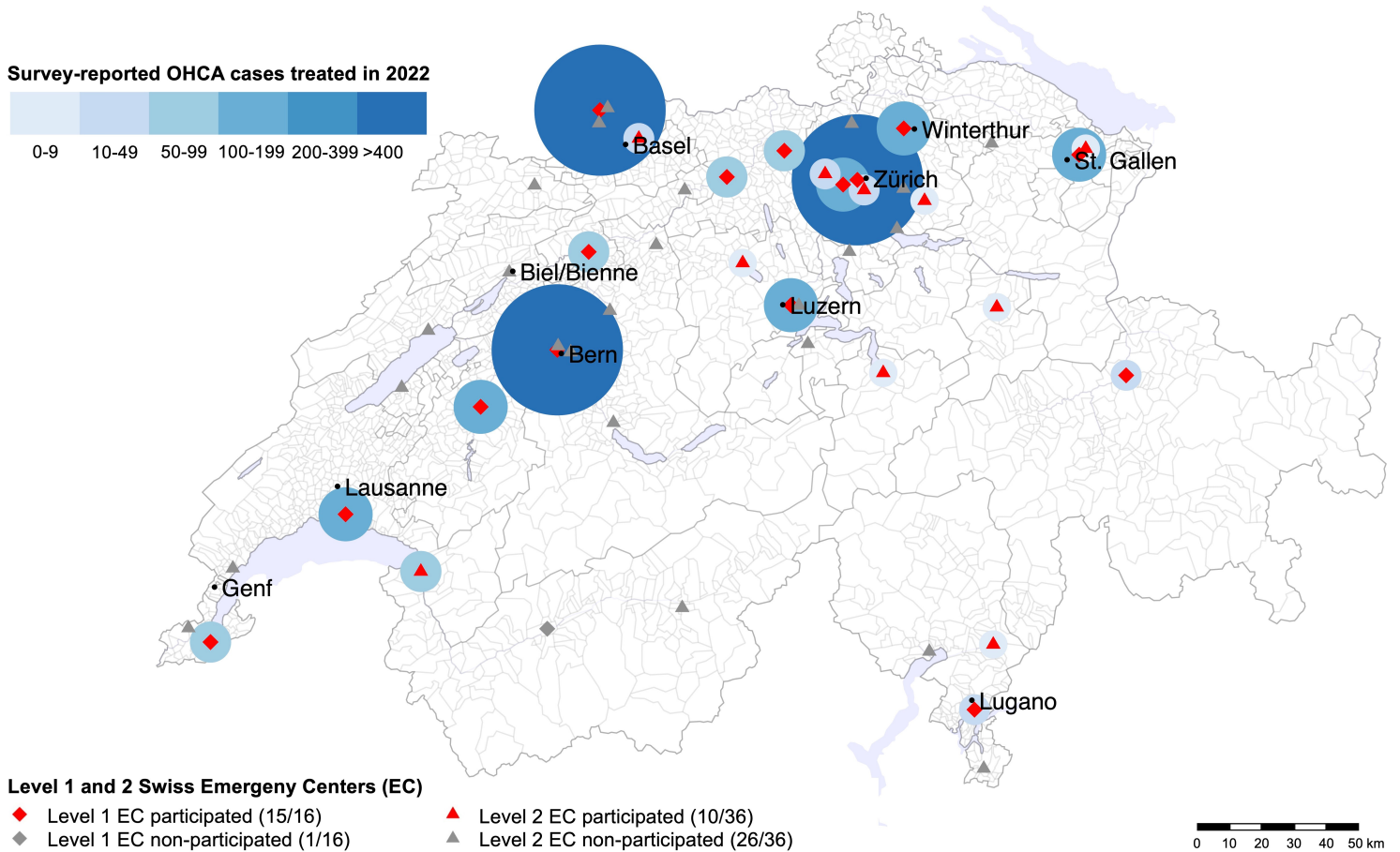
		Level 1 EC (n = 15)	Level 2 EC (n = 10)
Infrastructure	Mean number of treatment bays (SD); range.	31.6 (9.7); 19–50	14.3 (6.0); 6–25
	Mean annual patient volume (SD); range.	49,867 (19,272); 24,000–100,000	19,600 (10,783); 8000–35,000
OHCA caseload	OHCA cases in 2022: Median (IQR); range.	133 (IQR: 63–161); 27–580	6.5 (IQR: 4–19); 0–50
	Patients arriving under ongoing CPR in 2022: Median (IQR); range.	28 (IQR: 20–75); 7–305	3.5 (IQR: 2–10); 0–30
Data availability & quality	Centres without structured OHCA database	40%*	60%*
	Centres with structured OHCA database	60%*	40%*
	German CPR registry	7%*	0%*
	Hospital-developed database	20%*	10%*
	SWISSRECA database used	13%*	0%*
	COPRA patient data management system	13%*	0%*
	Retrospective case-counting post-survey	7%*	20%*
Data from previous research project	0%*	10%*	
Research engagement & interest	EC actively conducting resuscitation research	20%*	0%*
	EC with interest in future research projects	93%*	50%*
	Conditions required for future collaboration	Ethical approval, sufficient funding, institutional relevance.	Small-scale studies due to limited resources and personnel availability.

* Multiple answers were possible for registry use so totals may exceed 100%.

COPRA: Computer-based Patient Record and Analysis system; CPR: cardiopulmonary resuscitation; EC: emergency centre; IQR: interquartile range; OHCA: out-of-hospital cardiac arrest; SD: standard deviation; SWISSRECA: Swiss Registry of Cardiac Arrest.

Figure 2 illustrates the distribution of emergency centres across Switzerland, along with their survey participation and reported number of OHCA cases treated in 2022.

Figure 2: Geographical distribution of participating and non-participating emergency centres and survey-reported OHCA cases treated in 2022 (the size and colour of the circles around a centre correspond to the number of cases).



Challenges in local implementation

The main barriers to effective OHCA management differed between Levels, but several themes were consistent across institutions. Leadership challenges in Level 1 centres were primarily related to managing multidisciplinary teams, whereas Level 2 centres reported staff shortages and coordination difficulties. Shared challenges included maintaining training continuity and protocol adherence despite rotating staffing (table 2).

Table 2: Key challenges in local implementation and standardisation of resuscitation management in Swiss emergency centres. Responses were summarised qualitatively and grouped thematically according to the most frequently reported challenges. Each theme includes representative examples provided by emergency centres (ECs) of both Levels. Multiple responses per centre were possible.

Challenge	Level 1 EC (n = 15)	Level 2 EC (n = 10)	Shared and General Challenges
Leadership & Coordination	Managing diverse, multidisciplinary teams with variable experience levels	Coordination difficulties due to limited personnel and constrained resources	Ensuring leadership continuity throughout resuscitation
Training & Education	Variability in staff qualifications and training frequency	Limited access to structured training due to staff turnover	Maintaining regular resuscitation training despite rotating staff
Resources & Staffing	Sufficient but unevenly distributed expertise	Overall shortage of staff and limited resources for continuous improvement	Frequent staffing changes hinder consistent training and protocol adherence
Standardisation & Protocols	Difficulties implementing uniform procedures across shifts	Adapting standardised protocols to local resource constraints	Ensuring protocol compliance amid alternating personnel

Training, team composition and resuscitation protocols

Simulation-based training was conducted in almost all centres, with ACLS certification being mandatory in 73% of Level 1 but only 20% of Level 2 centres. Table 3 details the scope of ACLS certification requirements and outlines team composition, communication strategies and debriefing practices. Structured debriefing frameworks were reported in 33% of Level 1 and 40% of Level 2 centres (table 3).

Table 3: Training, team composition and resuscitation protocols. The denominator used for percentages is the number of responding centres of each Level (15 for Level 1, 10 for Level 2). Percentages below 10% are rounded to one decimal for clarity. Multiple answers were possible for handover methods so totals may exceed 100%.

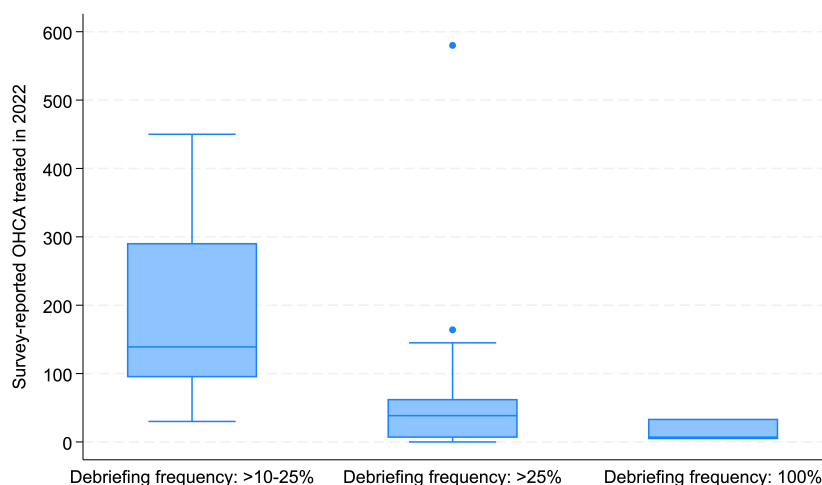
		Level 1 EC (n = 15)	Level 2 EC (n = 10)
Training and certification	Simulation-based resuscitation training conducted	87%	100%
	ACLS certification mandatory	73%	20%
	ACLS required for all team members	53%	0%
	ACLS required for senior physician and higher ranks	13%	20%
	ACLS required for all permanent emergency bay staff	7%	0%
	Biennial ACLS refresher mandatory	45% (of those with mandatory ACLS)	100% (of those with mandatory ACLS)
Team composition	Team size (day shift): mean (SD); range.	7.4 (1.7); 5–10	7.3 (1.6); 5–10
	Team size (night shift): mean (SD); range.	6.9 (1.9); 5–10	5.2 (1.0); 4–7
	N° of specialties per team: mean (SD).	4.2 (1.4)	3.5 (1.3)
	Common medical specialisations	EM: 87%, Anaesth: 80%, ICM: 27%, IM: 27%	EM: 80%, Anaesth: 60%, Cardio: 10%, ICM: 10%
Leadership	Primary leadership specialisation	EM: 60%	EM: 50%
	Dual specialisation leadership (EM + Anaesth)	20%	20%
	Other single specialties	IM: 7%, ICM: 7%	Anaesth: 10%, IM: 10%
	Leadership rotation by shift*	0%	10%
Communication and handover strategies	Structured handover process present	67%	50%
	... cABCDE	67%	50%
	... SAMPLE	47%	50%
	... SBAR	27%	20%
	... ATMIST	13%	10%
	No formal handover protocol	7%	10%
Debriefing practices	EC with structured debriefing concept	33%	40%
	... CRM-based debriefing	13%	0%
	... Hot-debriefing model [#]	7%	0%
	... STOP debriefing model	7%	0%
	... PEARLS debriefing model	0%	10%
	Institutionally developed debriefing framework	0%	10%
	Debriefing integrated into resuscitation protocol	0%	10%
	Leadership-dependent debriefing	0%	10%
	Debriefing framework in development	7%	0%

* Day shift: EM; Night shift: Anaesth or IM. Hot-debriefing: Immediate feedback round after resuscitation.

ACLS: Advanced Cardiac Life Support; Anaesth: Anaesthesia; ATMIST: Age Time Mechanism Injuries Symptoms Treatment; cABCDE: critical bleeding Airway Breathing Circulation Disability Environment; Cardio: Cardiology; CRM: Crisis Resource Management; EM: Emergency Medicine; ICM: Intensive Care Medicine; IM: Internal Medicine; PEARLS: Promoting Excellence and Reflective Learning in Simulation; SAMPLE: Symptoms Allergies Medication Last Oral Intake Exposure; SBAR: Situation Background Assessments Recommendation; STOP: Summarise Things that went well Opportunities to improve Points to action and responsibilities.

A notable trend was observed in centres with higher OHCA case volumes, which reported lower overall debriefing rates. However, debriefing frequency differed across institutions, with 70% of Level 2 centres reporting debriefing rates above 25%, and 20% conducting debriefings after every resuscitation (figure 3).

Figure 3: Box plot diagram of survey-reported OHCA cases treated in 2022 stratified by debriefing frequency (10–25%, >25%, 100%). Boxes show interquartile range (IQR), the horizontal line indicates the median, whiskers denote 1.5 x IQR and dots represent outliers.



Clinical management and technical resources

Table 4 provides an overview of technical and procedural resources available across emergency centres. Most Level 1 centres (73%) had a written standard operating procedure (SOP) for resuscitation, compared with 80% of Level 2 centres. Mechanical chest compression devices were available in 80% of Level 1 and 30% of Level 2 centres, with the LUCAS device being most frequently used. ECMO capability was reported by 73% of Level 1 centres and 10% of Level 2 centres.

Table 4: Clinical and technical resources for OHCA management in Swiss emergency centres. The denominator used for percentages is the number of responding centres of each Level (15 for Level 1, 10 for Level 2). The table summarises clinical management strategies and availability of technical resources related to out-of-hospital cardiac arrest (OHCA) care in Swiss emergency centres. Reported difficulty values reflect institutional self-assessment based on current practices and infrastructure.

		Level 1 EC (n = 15)	Level 2 EC (n = 10)
Resuscitation protocol	SOP for resuscitation available	73%	80%
	Primary reference sources for SOP	Resuscitation guidelines, EM congresses	Resuscitation guidelines, EM congresses
	Authorised representative for SOP updates	53%	50%
	In-house ACLS-certified expert managing SOP	13%	0%
Mechanical chest compression devices	Device available	80%	30%
	Most frequently used device	LUCAS (47%)	LUCAS (30%)
	Other devices used	AutoPulse (27%), Corpuls (7%)	AutoPulse (10%)
	Use only in specific scenarios*	13%	
Extracorporeal Membrane Oxygenation	ECMO insertion capability	73%	10%
	Written SOP for ECMO decision-making	67%	10%
Defibrillation strategies	Integration of DSD and/or VCD concepts	47%	40%
	Focus on ventilation optimisation	7%	0%
Challenges in medical decision-making	Key difficulties identified	TOR decisions, interdisciplinary communication, cause and prognosis assessment, post-resuscitation phase.	TOR decisions, interdisciplinary communication, cause and prognosis assessment, post-resuscitation phase.

* Scenarios e.g. prolonged CPR, hypothermia. # Isolated initiative in one centre. ACLS: Advanced Cardiovascular Life Support; CPR: Cardiopulmonary Resuscitation; DSD: Double Sequential Defibrillation; ECMO: Extracorporeal Membrane Oxygenation; EM: Emergency Medicine; SOP: Standard Operating Procedure; TOR: Termination of Resuscitation; VCD: Vector-Change Defibrillation.

Discussion

This survey is the first to detail CPR management in Swiss emergency centres, identifying system gaps and practice variation. The results revealed substantial variability in resuscitation training, team structures, communication strategies, protocol adherence and data collection across emergency centres. Advanced measures such as ECMO and mechanical chest compression devices are primarily available in Level 1 centres, whereas Level 2 centres report more frequent staff shortages and coordination challenges. These differences depict the heterogeneity in organisational structures, resource allocation and educational practices, indicating a need for standardised national strategies in CPR management. To better interpret the implications of these findings and to identify opportunities for optimisation, the following discussion will explore the key aspects of CPR management in Swiss emergency centres, highlighting strengths, gaps and potential areas for improvement.

Source of data and advantages of a national data system

The SWISSRECA registry provides essential prehospital OHCA data in Switzerland, maintained through mandatory reporting by certified EMS providers [16]. However, hospital-based and outcome data are incomplete, with inconsistent participation by emergency centres. This study found that 47% of Level 1 and 80% of Level 2 centres lack structured OHCA databases, often relying on retrospective counts or estimations.

This highlights the need for an integrated system linking prehospital, in-hospital and outcome data. Although SWISSRECA contributes to the EuReCa THREE study led by the ERC [20–22], the registry currently covers only the prehospital phase. Without standardised hospital-level documentation, national resuscitation data remain fragmented, limiting benchmarking and quality improvement [23]. A standardised OHCA data registration system across all hospitals and emergency services could identify disparities of outcomes based on demographics [24], enable benchmarking and ultimately improve patient outcomes. Germany's German Cardiac Arrest Registry (G-CAR) could serve as a useful model as it prospectively integrates all phases of OHCA care and links them to certified Cardiac Arrest Centres (CAC) [25, 26]. CAC certification mandates the availability of ECMO and therefore improves neurological outcomes, although current evidence shows no significant increase in survival to discharge after CAC certification [27, 28]. These findings indicate a need for further research in Switzerland, particularly in relation to regional variability in OHCA outcomes.

Beyond data registration, a standardised protocol – mandatory in CAC-certified centres – could improve both educational efficiency and patient outcomes. Bern University Hospital exemplifies how structured SOPs provide a framework for standardised decision-making (appendix 2). Regular feedback loops and inter-institutional benchmarking, as emphasised in the Utstein formula of survival, would be crucial for optimising OHCA management in Switzerland.

Lower reported OHCA numbers in Western Switzerland may be due to stricter termination-of-resuscitation (TOR) protocols. Emergency physicians dispatched to suspected OHCA cases may decide against initiating or continuing resuscitation based on futility, leading to more selective transport strategies [29–31].

Another contextual factor is the demography of some urban regions in Western Switzerland, where a younger population might contribute to a lower overall incidence of OHCA [32]. Finally, variation in documentation practices – especially in centres without databases – may also influence reported case numbers.

Mode of transportation

The survey examined whether OHCA patients arrived with Return Of Spontaneous Circulation (ROSC) or under ongoing CPR. A higher proportion of patients arrived under CPR in Level 2 centres, raising questions about prehospital triage and alignment with hospital resources. While Level 1 centres treat more OHCA cases and offer advanced therapies like ECMO, current routing does not always reflect this capacity. A centralised triage approach could improve outcomes by directing refractory OHCA cases to high-volume centres with ECMO availability.

A meta-analysis showed that CPR quality during transport is more critical than transport itself, with no survival or neurological benefit for immediate transport compared with on-scene resuscitation [33]. Data from Bern University Hospital showed higher mortality in patients transported under CPR (69.8%) than in those with ROSC (5.7%). Within the ROSC group, age and female sex were associated with worse outcomes [34]. Differences may reflect varying cardiac-arrest cir-

cumstances and hospital management strategies, as suggested by the Targeted Temperature Management study [35]. Although patient outcome data were not collected in this survey, external findings highlight the relevance of prehospital decision-making. International Liaison Committee on Resuscitation (ILCOR) consensus papers from 2020 and 2022 recommend on-scene CPR over transport CPR unless ECMO is available, as CPR quality deteriorates in transit and increases paramedic injury risk [36, 37].

These findings highlight the importance of aligning transport destinations with available hospital resources. Despite 73% of Level 1 centres offering ECMO compared with only 10% of Level 2 centres, more patients were transported under CPR to the latter. Evidence from SAVE-J III (Japan) [38] and Tonna et al. [39] shows that higher ECMO case volumes correlate with better survival and fewer complications. Implementing structured triage protocols could ensure that eligible patients are routed to adequately equipped centres. Further research should evaluate existing triage pathways and regional variability in transport decisions.

Communication strategies: challenge and chance in developing favourable team dynamics

Debriefing practices after resuscitation varied considerably across centres, and only a few used structured models such as CRM, STOP or PEARLS. While CRM training has shown benefits in team communication during crises, there is limited research evaluating STOP or PEARLS models specifically [40, 41]. Nonetheless, a structured debriefing is consistently associated with better teamwork, leadership and patient safety [42]. Virtual reality-based training may further enhance learning through immersive, reproducible and engaging feedback sessions [43].

Interestingly, centres with fewer OHCA cases conducted debriefings more frequently, possibly to compensate for limited exposure and to strengthen team reflection. In high-volume centres, targeted debriefings after critical cases may be more efficient, suggesting that debriefing strategies should be adapted to the institutional context [44].

Structured handovers represent another critical aspect of team communication. While most centres use a structured handover process, the methods differ. Many rely on cABCDE for clinical prioritisation, while tools like SBAR or ATMIST are less common. This may reflect a tendency to focus on clinical assessment rather than communication standardisation. However, standardised handover tools improve interdisciplinary coordination and reduce information loss during transitions [45, 46]. Simulation-based training could therefore strengthen consistency and efficiency across resuscitation teams.

Technical progress in resuscitation

According to the 2022 ILCOR consensus, mechanical chest compression devices should be considered for CPR during transport [37]. In this survey, 80% of Level 1 and 30% of Level 2 centres reported using such devices. Among Level 1 centres, 13% used them only for specific indications like hypothermia or prolonged resuscitation. These devices also serve to reduce workload and enhance safety in emergency settings.

Evidence on outcome benefits remains mixed. While adequate cerebral perfusion is associated with higher ROSC rates [47], a porcine model showed better circulation but no mortality benefit [48]. A meta-analysis found more CPR-related injuries under mechanical compression, though life-threatening events were comparable [49]. Thus, mechanical CPR seems most useful in transport or when manpower is limited, while manual CPR remains appropriate otherwise.

ECMO availability differed markedly, reported in 73% of Level 1 and 10% of Level 2 centres, with 93% of ECMO-capable centres having written SOPs.

The 2021 ERC guidelines support eCPR for specific cases, e.g. short downtime, high-quality prehospital CPR and shockable rhythms [49–51]. The Swiss Academy of Medical Sciences (SAMS) guidelines further highlight consideration of patient preferences [49], and the German S3 guidelines of 2021 recommend local, written SOPs [52]. The high adherence among Swiss centres indicates strong alignment with international standards.

Team composition and shift variations in emergency centres

The survey showed that Level 1 centres had an average team size of 7.4 (SD: 1.7) during the day shift and 6.9 (SD: 1.9) at night. In Level 2 centres, the night shift reduction was more pronounced, which may impact response time and decision-making in resuscitation.

However, increasing team size does not automatically enhance CPR effectiveness. A simulation study comparing 2-, 3- and 4-person paramedic crews found no significant differences in performance [53]. Most Level 1 centres had emergency medicine specialists leading resuscitation teams, ensuring consistent decision-making, whereas some Level 2 centres used a shift-dependent leadership model, potentially affecting coordination.

Leadership is a critical factor in team performance. Studies show that poor leadership behaviours negatively impact CPR quality [59,60]. Leaders adopting a “hands-off” approach – focusing on oversight rather than direct intervention – have been associated with improved team structure and cooperation during resuscitation [56]. Promoting such leadership behaviours and structured training may strengthen performance across emergency centres, regardless of the leader’s specialty background.

Limitations

This study has some limitations. First, as an online survey, there was no control over who completed it at each emergency centre or how accurately the data were retrieved. Moreover, the survey format did not allow for clarification or follow-up questions. To address this, open-response fields were included to enable additional comments [57]. However, such fields also pose challenges – they are time-consuming and may result in data that are harder to interpret and less suitable for robust analysis [58]. Second, the Delphi consultation used to test the questionnaire involved a single-centre expert panel. This could have introduced institutional bias, as the reviewers may have been influenced by their own centre’s resuscitation practices. Involving a multicentre panel might have reduced this risk and improved objectivity [59]. Lastly, the more intensive follow-up process for Level 1 centres – through prior contact and multiple reminders – may have influenced participation rates and skewed the sample towards higher-volume institutions. However, given their greater experience with OHCA cases, this targeted approach may be justified to ensure that the study captured insights from the most relevant centres.

Conclusions

This study provides the first comprehensive assessment of CPR management in Swiss emergency centres, highlighting significant heterogeneity in CPR management and data collection. While resuscitation training and ACLS certification are widely implemented, their standardisation remains inconsistent, particularly in level 2 centres. Differences in team composition, leadership and communication strategies further emphasise the need for structured training programmes and clear protocols.

Despite the availability of ECMO and mechanical chest compression devices in some centres, allocation of OHCA patients under ongoing CPR or ROSC remains uneven, potentially affecting patient outcomes. Decision-making challenges related to termination of resuscitation, interdisciplinary coordination and post-resuscitation care persist, underscoring the importance of guideline development and training. A nationally standardised OHCA data registry is crucial for improving patient outcomes, enabling benchmarking and ensuring evidence-based optimisation of emergency care. The findings support efforts to align Swiss CPR management with international best practices and emphasise the need for further research and collaboration to enhance patient survival and neurological recovery.

Data sharing statement

The dataset supporting the conclusions of this study consists of aggregated, anonymised survey results and does not include any identifiable personal or institutional data. Deidentified data elements and the survey instrument are available from the corresponding author upon reasonable request for research purposes related to emergency medicine, resuscitation management or health services research. No data dictionary or additional documents will be publicly deposited, as the dataset contains information that could indirectly identify participating centres. Data will remain accessible for a period of five years after publication.

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Appendix 1. Survey

Survey on CPR management

Dear Sir or Madam

We are conducting a study on the management of resuscitation in non-traumatic cardiac arrest cases in Swiss emergency centers as part of a doctoral thesis at the University Department of Emergency Medicine (UKN) at Inselspital Bern.

To gather insights, we are distributing a survey to all SGNOR Level 1 and Level 2 training centers across Switzerland. This survey will inquire about your emergency center's approach to cardiopulmonary resuscitation (CPR) management. It consists of 27 questions and will take approximately 10-15 minutes to complete. The survey pertains to the calendar year 2022.

We greatly appreciate your participation in this survey and thank you for your valuable time and contributions.

Best regards,

The UKN Study Team

(cand. med. Luisa Steiner, Dr. med. Sabrina Lanz, Prof. Dr. med. Martin Müller)

Q1 Please select your emergency center:

List of Level 1 and Level 2 emergency centers

Q2 How many emergency berths does your emergency center have?

Amount emergency berths

Q3 Please provide the total number of treated patients at your emergency center in 2022 in thousands. (Example: 25 = 25'000)

Amount of patients treated in 2022

Q4 How many out-of-hospital resuscitations (non-traumatic cardiac arrests) with ongoing CPR upon arrival in emergency bay did your emergency center manage in 2022?

Amount of OHCA resuscitations with on going CPR at arrival in emergency bay in 2022

Q5 How many out-of-hospital resuscitations (non-traumatic cardiac arrests) with return-of-spontaneous-circulation (ROSC) upon arrival in emergency bay did your emergency center manage in 2022?

Amount of OHCA resuscitations with ROSC at arrival in emergency bay in 2022

Q6 Please specify the source of data of the patient numbers mentioned above:

- In-house resuscitation database
- Numbers counted as result of this survey
- Estimation
- Other source of data (please specify)

Survey on CPR management

Team and Communication

Q7 Which specialists are typically involved in resuscitation efforts at your emergency center? (Please select all that apply)

- Anesthesiologist
- Emergency physician
- Internist
- Cardiologist
- Intensive care physician
- Anesthesiology nurse
- Nursing specialist in emergency medicine
- Other (please specify)

Q8 Who typically assumes the role of team leader during resuscitation in the emergency bay at your emergency center? (Please select all that apply)

- Anesthesiologist
- Emergency physician
- Internist
- Cardiologist
- Intensive care physician
- Other (please specify)

Q9 How many individuals are involved in resuscitation efforts in the emergency bay during the day shift at your emergency center?

Amount of individuals involved during day shift

Q10 How many individuals are involved in resuscitation efforts in the emergency bay during the night shift at your emergency center?

Amount of individuals involved during night shift

Q11 Are there any differences in CPR management during the day shift compared to the night shift at your emergency center?

Open answer field

Q12 Are debriefings conducted after resuscitations to identify opportunities for improvement in future cases?

- Always
- Often (>25% of all resuscitations)

- Sometimes (>10-25% of resuscitations)
- Never
- Only under following circumstances: (please specify)

Q13 Does your emergency center have a debriefing concept or criteria in place?

- No
- Yes (please specify)

Survey on CPR management

CPR-Protocol and Training

Q14 Does your emergency center have a standardized handover process between the emergency medical service and the resuscitation team leader?

- Yes
- No

Q15 If 'yes' to question no. 14: which handover concepts are used? (Please select all that apply)

- cABCDE (critical bleeding; **A**irway; **B**reathing; **C**irculation; **D**isability; **E**xposure/**E**nvironment)
- SBAR (**S**ituation; **B**ackground; **A**ssessments; **R**ecommendation)
- ATMIST (**A**ge; **T**ime; **M**echanism; **I**njuries; **S**igns/**S**ymptoms; **T**reatment)
- SAMPLE (**S**ymptomatik; **A**llergien; **M**edikation; **P**atientenvorgeschichte; **l**etzte **N**ahrungsaufnahme; **E**reignisse)
- Other concepts (please specify)

Q16 Does your emergency center have a written resuscitation protocols or guideline?

- Yes
- No

Q17 How does your emergency center obtain information about updates to resuscitation recommendations? (Please select all that apply)

- Guidelines
- Congresses
- Inhouse representative
- Other (Please specify)

Q18 Is it mandatory for all staff members who participate in resuscitations to have an ACLS certification at your emergency center?

- Yes
- No
- Other requirements (Please specify)

Q19 If 'yes' to question no. 18: are biennial ACLS refresher courses required?

- Yes
- No
- Other courses (Please specify)

Q20 Does your emergency center conduct regular resuscitation simulations in the emergency bay?

- Yes
- No

Q21 Are the cabinets in your emergency bay clearly labeled for quick access to resuscitation materials and tools?

- Yes
- No

Q22 Does your emergency center use mechanical chest compression devices during resuscitation?

- LUCAS
- Corpuls
- AutoPulse
- No mechanical chest compression are used
- Other devices (Please specify)

Q23 Does your emergency center have access to extra corporeal membrane oxygenation (ECMO/eCPR) for selected patients with cardiac arrest?

- Yes
- No

F24 If 'yes' to question no. 23: Does your emergency center have a standard operating procedure (SOP) for eCPR?

- Yes
- No

Survey on CPR management

Challenges and Resuscitation Research

Q25 What are the greatest challenges in resuscitation at your emergency center?

Open answer field

Q26 Is research on resuscitation conducted at your emergency center?

- Yes
- No

Q27 Does your emergency center engage with 'double sequential defibrillation' or 'vector change defibrillation'?

- Yes
- No
- Other topics that your emergency center is currently researching: (please specify)

Q28 Is there interest in conducting resuscitation research at your emergency center?

- Yes
- No
- If yes: Under which conditions? (open answer field)

Survey on CPR management

Thank you for your time and participation!

You have completed the survey. If you would like to receive the study results, please provide your contact details below.

Best regards

The UKN study team

(cand. med. Luisa Steiner, Dr. med. Sabrina Lanz, Prof. Dr. med. Martin Müller)

Q29 Please enter your contact details:

Name:

Emergency center:

Mail address:

Appendix 2. Standard Operating Procedure (SOP) for OHCA Patients – University Hospital of Bern.

This SOP outlines the structured clinical pathway for OHCA patients, ensuring standardized decision-making from prehospital EMS notification to definitive hospital care.

