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Review

Overview and future prospects of out-of-hospital cardiac arrest registries in Japan

Yohei Okada[a,b,1,*], *Koshi Nakagawa*[c], *Hideharu Tanaka*[c], *Haruka Takahashi*[d], *Tetsuhisa Kitamura*[e,1], *Takeyuki Kiguchi*[b,f,1], *Norihiro Nishioka*[b,1], *Nobuya Kitamura*[g,2], *Takashi Tagami*[h,2,3], *Akihiko Inoue*[i,4], *Toru Hifumi*[j,4], *Tetsuya Sakamoto*[k,4], *Yasuhiro Kuroda*[l,4], *Taku Iwami*[b,1]

Abstract

Aim: Out-of-hospital cardiac arrest (OHCA) is a life-threatening emergency with high mortality. The "chain of survival" is critical to improving patient outcomes. To develop and enhance this chain of survival, measuring and monitoring the resuscitation processes and outcomes are essential for quality assurance. In Japan, several OHCA registries have successfully been implemented at both local and national levels. We aimed to review and summarise the conception, strengths, and challenges of OHCA registries in Japan.

Method and results: The following representing registries in Japan were reviewed: the All-Japan Utstein registry, the Utstein Osaka Project/the Osaka-CRITICAL study, the SOS-KANTO study, the JAAM-OHCA study, and the SAVE-J II study. The All-Japan Utstein registry, operated by the Fire and Disaster Management Agency of Japan and one of the largest nationwide population-based registries in the world, collects data concerning all patients with OHCA in Japan, excluding in-hospital data. Other research- and hospital-based registries collect detailed out-of-hospital and in-hospital data. The Osaka-CRITICAL study and the SOS-KANTO study are organized at regional levels, and hospitals in the Osaka prefecture and in the Kanto area participate in these registries. The JAAM-OHCA study is managed by the Japanese Association of Acute Medicine and includes 107 hospitals throughout Japan. The Save-J II study focuses on patients with OHCA treated with extracorporeal cardiopulmonary resuscitation.

Conclusion: Each OHCA registry has its own philosophy, strengths, perspectives, and challenges; however, all have been successful in contributing to the improvement of emergency medical service (EMS) systems through the quality improvement process. These registries are expected to be further utilized to enhance EMS systems and improve outcomes for patients with OHCA, while also contributing to the field of resuscitation science.

Keywords: Emergency medicine, Resuscitation, Epidemiology, Cardiac arrest

Abbreviations: AED, automated external defibrillator, ALS, advanced life support, CC-CPR, chest compression-only cardiopulmonary resuscitation, CCMCs, critical care medical centres, CPR, cardiopulmonary resuscitation, ECMO, extracorporeal membrane oxygenation, ECPR, extracorporeal cardiopulmonary resuscitation, EMS, emergency medical service, FDMA, Fire and Disaster Management Agency, OHCA, out-of-hospital cardiac arrest, PAD, public access defibrillation, PCI, percutaneous coronary intervention, PEA, pulseless electrical activity, RCT, randomized controlled trial, ROSC, return of spontaneous circulation, TTM, target temperature management, VF, ventricular fibrillation

* Corresponding author at: Department of Preventive Services, Kyoto University, Kyoto, Japan.

E-mail addresses: yohei_ok@duke-nus.edu.sg, yokada-kyf@umin.ac.jp (Y. Okada), n.koshi@kokushikan.ac.jp (K. Nakagawa), hidetana@kokushikan.ac.jp (H. Tanaka), 23rdb03@nittai.ac.jp (H. Takahashi), lucky_unatan@yahoo.co.jp (T. Kitamura), take_yuki888@yahoo.co.jp (T. Kiguchi), nishioka.norihiro.7f@kyoto-u.ac.jp (N. Nishioka), kitaccm2000@icloud.com (N. Kitamura), t-tagami@nms.ac.jp (T. Tagami), i.akihiko1985@gmail.com (A. Inoue), hifumitoru@gmail.com (T. Hifumi), sakamoto.tetsuya@nifty.ne.jp (T. Sakamoto), kuroda.yasuhiro@kagawa-u.ac.jp (Y. Kuroda), iwami.taku.8w@kyoto-u.ac.jp (T. Iwami).

[1] Osaka-CRITICAL Study group.

[2] SOS-KANTO study group.

[3] JAAM-OHCA registry committee.

[4] The SAVE-J II study group.

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Introduction

Out-of-hospital cardiac arrest (OHCA) represents one of the most severe medical emergencies, often resulting in high mortality.[1,2] The effective application of the chain of survival, a critical sequence of coordinated actions, is key to improving outcomes for patients with OHCA.[1,2] This includes immediate recognition of cardiac arrest and activation of the emergency medical service (EMS) system, early initiation of cardiopulmonary resuscitation (CPR), and prompt administration of defibrillation, followed by high-level in-hospital care. To develop and enhance the chain of survival, the measurement and monitoring of resuscitation processes are required for quality assurance (Fig. 1).[3] Moreover, investigating underlying mechanisms or modifiable factors may drive innovation and provide feedback for clinical settings to further improve patient outcomes.[3] However, enabling this valuable cycle of enhancement demands robust and comprehensive data collection across each relevant region.[4,5]

A comprehensive registry, however, relies on significant contributions from stakeholders and a consistent effort is required for development and maintenance. In Japan, several OHCA registries have been successfully implemented at both local and national levels, owing to the support of paramedics, clinicians, researchers, and related academic associations. The Utstein Osaka Project, the first large-scale, population-based OHCA registry using the Utstein format, was launched in 1996 covering the Osaka Prefecture, which has 8.8 million residents. Following its success, the nationwide All Japan Utstein Registry was initiated in 2005.[6–8] Additionally, two prospective registries (the Osaka CRITICAL registry and the SOS-KANTO study) began collecting comprehensive data including in-hospital care, in addition to pre-hospital data in the Kanto regions and in Osaka.[9,10] They have expanded to encompass the national-level registry (JAAM-OHCA registry).[11] Furthermore, a dedicated registry (SAVE-J II study) has also been established specifically to collect data concerning extracorporeal CPR (ECPR).[12] Summarizing the concepts, strengths, and challenges of these registries may be valuable in advancing international research collaboration and implementing the OHCA registry worldwide (Table 1).

This article aimed to review how resuscitation was performed in pre-hospital and in-hospital settings, and to summarize the concepts, implementation, strengths, and challenges of OHCA registries in Japan to enhance international collaboration and improve the understanding of clinical research on OHCA.

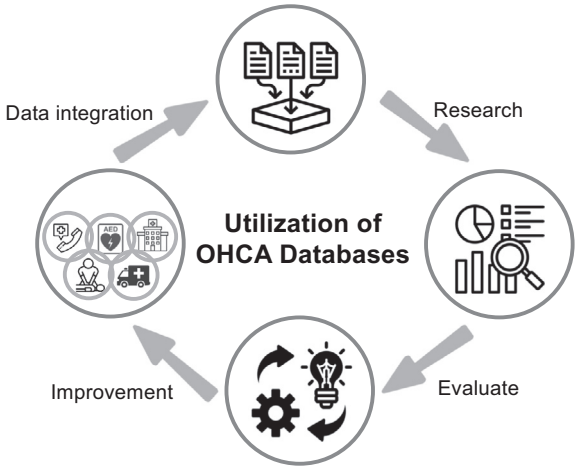

Fig. 1 – The registry for quality assurance and improvement. Clinical data on resuscitation are integrated into the registry and the data is utilized for research. Through research, the resuscitation process and procedures are evaluated and contribute to further improvement. OHCA: Out-of-hospital cardiac arrest.

The pre-hospital EMS system in Japan

The pre-hospital EMS system and the epidemiology of OHCA in Japan are first reviewed to facilitate understanding of OHCA registries in Japan.

Epidemiology of pre-hospital emergency care in Japan

As a super-aged society, Japan has a population of approximately 126 million people, with older adults aged ≥65 years comprising approximately 30% of this population.[13] The number of emergency dispatches has been increasing annually, with approximately 6.2 million ambulances dispatched in 2021.[14] With this increase in emergency demand, the average time from emergency requests to ambulance arrival at the scene has also extended, from a national average of 8.2 minutes in 2011 to 9.4 minutes in 2021.[14] There are approximately 120,000 incidences of OHCA annually. Among those witnessed by citizens, the one-month survival rate is approximately 12% (Fig. 2).[14]

The EMS system

Emergency medical care in Japan is provided 24/7 by the fire departments of local governments under the supervision of the Fire and Disaster Management Agency (FDMA) of Japan. There are 724 fire departments nationwide, with 5302 emergency ambulances.[14] Each ambulance is staffed with three emergency medical technician (EMT), with at least one being a nationally certified emergency lifesaving technician (ELST). The nationwide emergency call number is '119.' The nearest ambulance is dispatched from the dispatch centre of each fire department, and patients are transferred to hospitals. If the ambulance is expected to take a long time to arrive or if more personnel are required (such as for patients found in confined spaces), a fire engine is also dispatched (pumper-ambulance collaboration) (Fig. 3). If OHCA is suspected based on information obtained during the emergency call, the dispatcher provides online help for the caller to provide CPR. Assistance by dispatcher is performed for approximately 60% of OHCAs, with bystander CPR performed in approximately 50% of OHCAs.[14].

The advanced life support (ALS) protocol

ELST in Japan are trained and authorized to provide some medical procedures such as intravenous access, adrenaline administration, and advanced airway management (tracheal intubation and supraglottic airway) for patients with OHCA under the online supervision of designated physicians. For certification of tracheal intubation by the relevant regional medical control council, ELSTs are required to attend an additional course (62hours), to have passed both practical and written tests prior to undertaking tracheal intubation, and to have performed successful intubations in 30 patients under the supervision of an anaesthesiologist in a medical institution. The ALS protocol for EMS personnel in Japan is also defined by each regional medical control council based on the Resuscitation

Table 1 – The characteristics of OHCA registries in Japan.

	All Japan Utstein Registry	SOS-KANTO Study	Osaka-CRITICAL Study	JAAM-OHCA Registry	SAVE-J II Study
Target population	All OHCA cases treated by the EMS	OHCA cases transferred to the participating hospitals	OHCA cases transferred to the participating hospitals	OHCA cases transferred to the participating hospitals	OHCA cases transferred to the participating hospitals and treated with V-A ECMO
Study design	Population-based registry	Prospective cohort study	Prospective cohort study	Prospective cohort study	Retrospective cohort study
Study period	2005-ongoing	2002–2004 2012–2013 2019–2021	2012-ongoing	2014-ongoing	2013–2018
Area	All Japan	Kanto region	Osaka Prefecture	All Japan	All Japan
Lead organization*	The FDMA	The steering committee in the JAAM of KANTO	CRITICAL study steering committee	The steering committee in JAAM	SAVE-J II Study Group
Number of participating hospitals	All OHCA patients in Japan	58 hospitals (2002–2003) 67 hospitals (2012–2013) 41 hospitals (2019–2021)	16 hospitals (2022)	107 hospitals (2022)	36 hospitals
Number of registered cases	About 120,000 cases /year	9592 cases (2002–2003) 16,452 cases (2012–2013) 9909 cases (2019–2021)	21,032 cases (2012–2021)	95,817 cases (2014–2021)	2157 cases(2013–2018)
Pre-hospital information	Utstein format	Utstein format	Utstein format	Utstein format	Utstein format
In-hospital information	NA	ED data and PCI, IABP, ECMO	ED data and PCI, IABP, ECMO	ED data and PCI, IABP, ECMO	ED data, PCI, IABP, ECMO and ICU
Outcome	One-month survival and CPC	One-month, three-month, and one-year survival and CPC	One-month and three-month survival and CPC	One-month and three-month survival and CPC	Survival, CPC at hospital discharge, and complication, etc.

OHCA, out-of-hospital cardiac arrest, EMS, emergency medical system, FDMA, Fire and Disaster Management Agency, JAAM, The Japanese Association for Acute Medicine, ECMO, Extracorporeal membrane oxygenation, ED, Emergency department, PCI, percutaneous coronary intervention, IABP, Intra-aortic balloon pumping, CPC, Cerebral performance category. * Each lead organization has the responsibility to collect and manage the data.

The All-Japan Utstein registry collects all OHCA cases nationwide, overlapping with other registries. SOS-KANTO and Osaka-CRITICAL are region-specific with no overlap, while JAAM-OHCA incorporates cases from Osaka, the Kanto regions, and additional areas, which means there is a potential overlap of cases between JAAM-OHCA and both the Osaka Critical/SOS-KANTO studies. SAVE-J II focuses uniquely on ECMO-treated OHCA cases, sharing some cases with the other studies.

Guidelines in Japan in consideration of the context and situation in each region.[15] Therefore, the presence or absence of ALS implementation, its timing, and the choice of advanced airway device can vary greatly by region.[16] Typically, ELSTs prioritise transferring patients with OHCA to hospitals with the minimum resuscitation procedures rather than staying at the scene. Thus, the median duration from patient contact to hospital arrival was reported as approximately 24 minutes.[16] Regarding termination in Japan, the termination of resuscitation by paramedics is strictly limited. Paramedics can terminate resuscitation only when cardiac arrest cases are clearly considered to be dead, such as when presenting with rigor mortis.

The All-Japan Utstein registry

The All-Japan Utstein Registry was reviewed to highlight landmark studies derived from this registry. In January 2005, the FDMA of Japan launched a prospective, nationwide, population-based cohort study of patients with OHCA using the standardized Utstein style.[17] This registry, known as the 'All-Japan Utstein Registry,' is the largest Utstein-style registry in the world. During the period when the registry was initiated in 2005, there had been several significant shifts in the pre-hospital EMS systems in Japan. Automated external defibrillator (AED) usage by citizens was legally permitted in July 2004, and public-access AEDs rapidly became more available. Specifically trained ELSTs (called emergency life-saving technicians) were permitted to perform tracheal intubation in July 2004 and to administer intravenous adrenaline in April 2006. Following these changes, the registry provided extensive data on the use of public-access AEDs and CPR by the general public, in addition to ALS by EMS personnel.

Among bystander-witnessed ventricular fibrillation (VF) arrests of cardiac origin, the time interval from collapse to defibrillation shortened as the number of public-access AEDs per inhabitant area increased, and the annual number of one-month survivals with

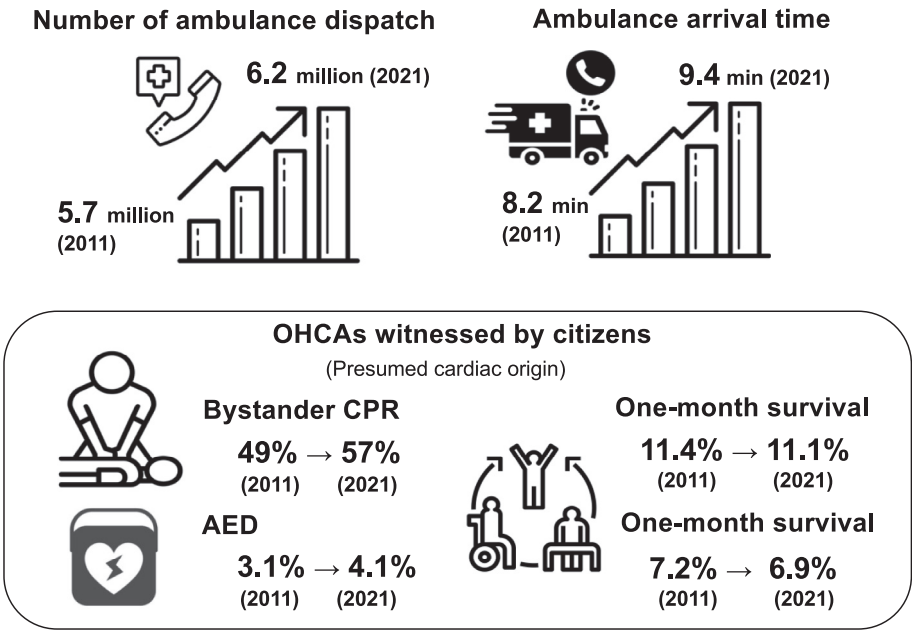

Fig. 2 – The epidemiology of EMS and OHCA in Japan. OHCA: Out-of-hospital cardiac arrest, AED: Automated external defibrillator. The number of "AED" means the frequency of shock given by bystander using AED. The data are sourced from the annual report of the Fire and Disaster Management Agency, which manages the All-Japan Utstein

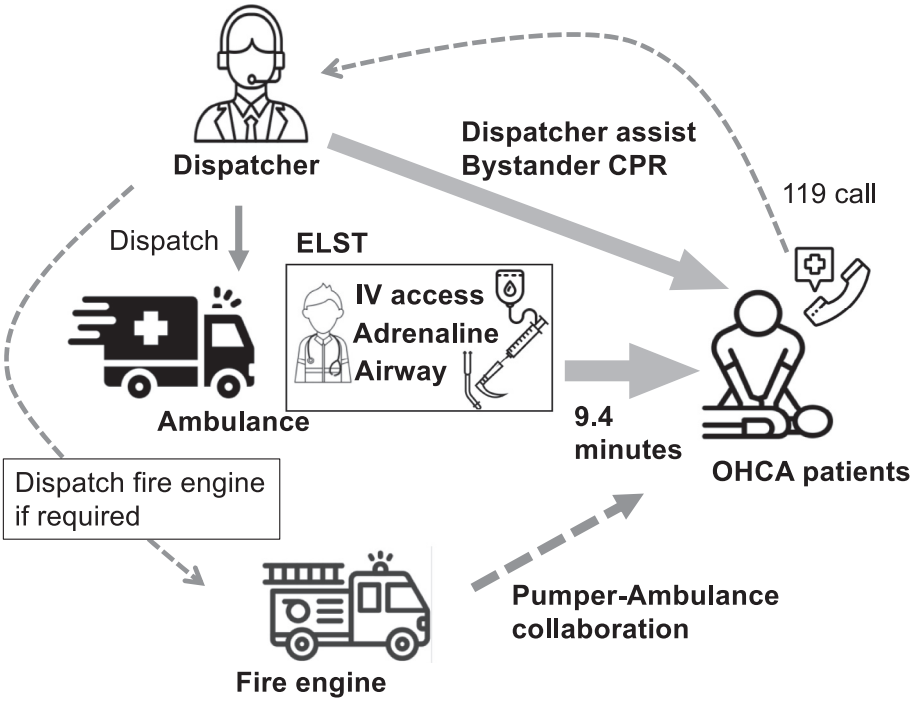

Fig. 3 – How the EMS system in Japan responds to OHCA case. OHCA: Out-of-hospital cardiac arrest, ELST: Emergency life-saving technician.

favourable neurological outcomes after public-access AED shock also increased as public-access AED density increased from 2005 to 2007.[8] Subsequently, the cumulative number of public-access AEDs reached 428,821 in 2013, and the proportion of patients receiving shocks using public-access AEDs increased from 1.1% in 2005 to 16.5% in 2013.[18] One study reported that one-month survival with a favourable neurological outcome was significantly higher in a public access defibrillation (PAD) group compared with a non-PAD group (38.5% versus 18.2%, respectively; adjusted odds ratio after propensity score matching; 1.99 [95% confidence interval

1.80–2.19]). In addition, even in patients without pre-hospital return of spontaneous circulation (ROSC) before EMS arrival, one-month survival with a favourable neurological outcome was significantly higher in those who received PAD than in those who did not.[19] Thus, earlier shock owing to nationwide dissemination of public-access AEDs resulted in increased survival after OHCA in Japan.

Data concerning the effectiveness and dissemination of CPR among the general public is available from this registry. In particular, evaluating the effectiveness of bystander CPR on paediatric OHCA has been important in resuscitation science. For children with OHCAs of non-cardiac origin such as respiratory origin, conventional CPR with rescue breathing by a layperson is the preferred approach to resuscitation. For OHCAs of cardiac origin, either conventional CPR or chest compression-only CPR (CC-CPR) have similar effects.[20] In addition, data derived from the All-Japan Utstein Registry also show CC-CPR for OHCA performed by a layperson has been disseminated widely in pre-hospital settings.[21] The number of patients with OHCA who received CC-CPR by a layperson increased from 17.4% in 2005 to 39.3% in 2012. The incidence of survival with favourable neurological outcomes attributed to CC-CPR also significantly increased.

The All-Japan Utstein Registry has also provided important findings regarding ALS by EMS personnel. Evaluating the effects of ALS measures (i.e., adrenaline administration and advanced airway management) using observational studies is challenging as EMS personnel can only provide general ALS measures for patients with OHCA who do not respond to basic life support. In two studies that used data from this registry, pre-hospital adrenaline administration[22] and advanced airway management[23] were associated with decreased survival outcomes in adult patients with OHCA. Importantly, resuscitation time bias (that is, patients undergoing longer resuscitation tend to receive more interventions) is a crucial bias in observational studies.[24] Subsequently, two studies, using time-dependent propensity score sequential matching to account for resuscitation time bias and timing of ALS measures, reported that pre-hospital epinephrine administration[25] and advanced airway management were associated with increased one-month survival in adult patients with non-VF.[26] Thus, these findings reinforce the importance of taking resuscitation time bias into account in resuscitation science observational studies.

The All-Japan Utstein Registry, which is also an important administrative resource on emergency resuscitation, enrols over 120,000 patients with OHCA every year. It remains ongoing without a set termination date and could be used to provide and disseminate valuable data from Japan internationally regarding pre-hospital resuscitation science.

The Utstein Osaka Project and the Osaka-CRITICAL study

The Utstein Osaka Project was the first large-scale, population-based OHCA registry using the Utstein format in Japan. It was launched in 1996 in the northern region of Osaka and developed to cover the entire Osaka Prefecture, with 8.8 million residents in 1998. Numerous data have been analysed from this benchmark registry, including data concerning the effectiveness of CC-CPR, the present situation concerning OHCAs, and the significance of the chain of survival.[27–29] As mentioned above, this Utstein Osaka Project was expanded to the nationwide All Japan Utstein Registry in 2005.[6–8] The Comprehensive Registry of In-Hospital Intensive Care for OHCA Survival (the Osaka-CRITICAL study) was developed based on the activity of the Utstein Osaka Project as a multicentre, prospective registry including consecutive cases of OHCA transferred to tertiary care centres in Osaka Prefecture. This registry was initiated with an overarching goal of enhancing outcomes for patients with OHCA.[9] Its utility has been evaluated about incorporating sophisticated in-hospital therapeutic strategies.[30] One study obtained in-hospital data from 15 tertiary critical care medical centres (CCMCs) and one non-CCMC community hospital with an emergency department all located in Osaka Prefecture in Japan.[31,32] Osaka Prefecture is an urban region with an area of 1905 km^2 and a residential population of approximately 8.8 million in 2015. In Osaka Prefecture, 7500 OHCAs occur annually, and approximately 25% of patients with OHCA (approximately $\geq$ 2000 cases) were registered every year from 2012 to 2021. This registry is ongoing, with an undefined study period. In-hospital data are recorded by physicians in charge of patients and registered by physicians or medical administrators using a pre-defined online form.

Using this registry, several landmark papers have been published. The registry holds data on laboratory biomarkers and in-hospital advanced procedures such as percutaneous coronary intervention (PCI), target temperature management (TTM), and ECPR; therefore, most studies have been published on these topics. For example, some studies reported that shorter no-flow or low-flow duration and higher pH values for blood gas assessment were associated with favourable neurological outcomes among patients with OHCA treated with ECPR.[33,34] Furthermore, a machine-learning model was developed to accurately predict outcomes among patients with OHCA and ROSC.[35] It was reported that the predictive value of electrocardiography findings was limited in predicting the necessity of PCI.[36] These studies have contributed to the assessment of predictive performance of clinical information and in-hospital procedures.

For further development of this registry, the research committee of the Osaka-CRITICAL study has started to include hospitals other than those in Osaka Prefecture. Furthermore, it is implementing information concerning how to terminate or withdraw resuscitation. Additionally, it intends to collect outcome data about health-related quality of life. These investigations are expected to have some technical challenges in terms of data collection and patient follow-up; however, these data will facilitate communication with the families of patients with OHCA when discussing resuscitation strategies in this super-aged society.

The SOS-KANTO study

Prior to commencement of the All-Japan Utstein Registry in 2005, the SOS-KANTO study, which integrated pre- and in-hospital data, was initiated in the Kanto region of Japan in 2002. The process of building this registry and its characteristics is described as follows. In 2000, no OHCA registry integrated both pre- and in-hospital information. Consequently, most data regarding OHCA were derived exclusively from either pre- or in-hospital registries.[37–41] Without an integrated registry, it was challenging to comprehensively assess resuscitation strategies including those at the scene and in hospital. To address this limitation, it was necessary to develop a registry with comprehensive data that could provide insights into factors changing over time and those associated with improved outcomes.

In 2002, the Japanese Association for Acute Medicine (JAAM) of KANTO initiated an investigation into the survival rates of patients with OHCA in the Kanto region, namely, the SOS-KANTO study.[10] This multi-centre collaborative study aimed to understand and contribute to the establishment of an EMS system for patients with OHCA. It represented the first expansive registry in Japan containing detailed information spanning both pre- and in-hospital stages. Between September 1, 2002, and December 31, 2003, a total of 9,592 OHCA cases were collected and verified from 58 facilities, encompassing comprehensive information in both pre- and in-hospital settings. Several papers have been published from this registry.[10,42–45] Notably, one publication showed that bystander-performed CC-CPR was not inferior to conventional resuscitation in terms of neurological outcomes.[45] This finding has had significant implications and has contributed to advancements in CPR practices globally.

In 2012, an updated version of the registry, namely, the SOS-KANTO 2012 study, was initiated across 67 centres within the same region. This study accumulated a total of 16,452 cases from January 2012 to March 2013.[46] Data from this period reflect the application of two major updates to the resuscitation guidelines (revised in 2005 and 2010). The study, using the revised version of the registry, indicated a notable improvement in favourable neurological outcomes compared with those in 2002. This finding may be attributed to the implementation of AEDs, which were permitted to be used by ELSTs without physician supervision in 2003 and by citizens in 2004 in Japan, whereas their use had previously been restricted.[8] Moreover, the scope of medical procedures and drug administration by emergency medical staff broadened during this time.[22,23,25] Furthermore, advancements in post-resuscitation care, encompassing strategies such as therapeutic hypothermia and PCI had a transformative effect on in-hospital resuscitation approaches.[47] The strength of this study lay in comparing two large registries before and after changes to the guidelines and pre- and in-hospital emergency medical systems for OHCA. The results of the 2012 study highlighted these changes and 34 studies were published.

Additionally, a new registry was planned in 2017. The patient data collection period was from September 2019 to March 2021, involving 9909 cases from 41 centres. However, the SOS-KANTO investigators confronted a challenge in terms of the COVID-19 pandemic in 2020 during the patient enrolment. In this period, the American Heart Association and other academic associations formulated an interim guideline for basic and advanced life support. At the same time, the Japanese government released the state of emergency declaration. The interim guidance recommended a balance between the need for urgent care for patients with COVID-19 and the protection of healthcare providers from infection. Thus, pre- and in-hospital care for patients with OHCA may have been limited due to the COVID-19 pandemic, owing to concerns regarding cross-infection between patients and healthcare providers. Therefore, a survey focusing on the early stages of the pandemic was conducted to explore the changes in protocols and the potential adverse effects of the revised protocol, such as interruptions in CPR, and to assess the risk of cross-infection to healthcare providers.[48] Based on the results of this survey, resuscitation protocols for all participating institutions have been revised, but few have changed protocols to be detrimental to OHCA. In addition to this, the SOS-KANTO has set 107 research themes in total, and some of them have been published.[49,50].

The JAAM-OHCA registry

Following the Osaka-CRITICAL and SOS-KANTO studies, the need for a nationwide registry integrating both pre- and in-hospital data began to gain attention. Accordingly, the Japanese Association for Acute Medicine (JAAM) initiated the “Special Committee for the Promotion of Society-led Research on the Construction of Effective Emergency Medical Systems and Treatment Strategies for Saving Out-of-Hospital Cardiac Arrest Cases” in 2014. To enhance survival rates for patients with OHCA, the society aimed to construct the “JAAM Multi-centre Collaborative Out-of-Hospital Cardiac Arrest Registry” (OHCA Registry), with objectives to generate new, Japan-originated evidence through the improvement of EMS systems based on objective verification and construction of an all-Japan system. The goals of the OHCA registry are as follows:

1. Support regional EMS system improvement tasks through management methods based on the plan, do, study, act (PDSA) cycle.
2. Aggregate in-hospital and out-of-hospital data related to emergency medical care and reduce the burden of registration tasks.
3. Promote clinical and epidemiological research in emergency resuscitation areas.
4. Provide feedback/benchmarking to participating facilities based on objective data.

As of December 2022, 107 facilities had registered 95,817 individuals. A characteristic of the OHCA Registry is that it includes detailed data and outcome information post-admission and correlates with Utstein data provided by the FDMA. Through aligning with Utstein data, it is possible to omit the input of pre-hospital information in participating facilities.

Any facility with a record of case registration in this registry can apply for data use. Every autumn, a call for themes is initiated, and approved themes are coordinated within the committee to avoid overlap with other researchers’ themes. The committee supports the provision of data and encourages analysis and paper write-up. It is a valuable registry collecting data from pre-hospital to post-admission treatments, and new participating facilities are continually being solicited. To date, 42 papers have been published.[51]

The SAVE-J II study

We also introduce a novel and original large-scale registry focusing on data concerning patients with OHCA treated with ECPR. ECPR is an advanced resuscitation procedure for refractory patients with OHCA using extracorporeal membrane oxygenation (ECMO).[52] While ECPR is expected to improve outcomes for patients with OHCA, it is a complicated treatment that requires substantial medical resources and experience, and can only be performed in a limited number of facilities. Furthermore, no guidelines have been established concerning appropriate candidates for ECMO, nor how to facilitate safe implementation, management, and complications. Thus, a multi-centre retrospective observational study was conducted in Japan to collect clinical data for adult patients with OHCA who underwent ECPR (the SAVE-J II study, UMIN-ID; UMIN000036490).[12] In this study, 36 facilities participated, and 2157 cases of OHCA treated with ECPR were registered between 2013 and 2018.

One strength of this study was its large number of ECPR cases. ECPR began in Japan in 1988 and the ECPR strategy has since

spread throughout Japan,[52] facilitating the development of this expansive registry. Another strength of this study was that high granularity data were collected in relation to complications and post-resuscitation care in critical care units, which are crucial data when comprehensively evaluating ECPR strategies.

The SAVE-J II study mainly analysed patient backgrounds, outcomes, and complications using real-world ECPR data in Japan. This study reported a 14.1% rate of favourable neurological outcomes at discharge and a 27.2% survival rate at discharge, while 32.7% of the cases had complications during ECPR, with the most common complication being bleeding.[12] This study also reported that the proportion of favourable neurological outcomes was 16.7%, 9.2%, and 3.9% in patients with shockable rhythm, pulseless electrical activity (PEA), and asystole, respectively. The survival rate at hospital discharge was 32.0%, 18.5%, and 10.8% for patients with shockable rhythm, PEA, and asystole, respectively.[12] The registry has collected extensive and detailed data, and several retrospective analyses are still ongoing.

Beyond the current initiatives, a randomized controlled trials investigating temperature management in ECPR is currently being prepared. Furthermore, establishing systems and teams to provide rapid and safe ECPR is needed. One study derived from the SAVE-J II study showed that complications during ECPR were observed in >30% of cases.[12] To reduce complications and provide safer ECPR, the development of generalized educational programs and protocols to promote safe and appropriate ECPR is needed. Furthermore, it is essential to develop systems that can provide prompt and safe ECPR using data obtained from experienced teams and facilities.

Limitations and challenges

Although these registries have significantly advanced resuscitation strategies in Japan, they do not come without limitations and challenges. As previously mentioned, resuscitation entails a series of coordinated actions, ranging from the recognition of cardiac arrest to the provision of standardised in-hospital care. Recently, new elements have been recognised as integral to this conventional chain of survival. These elements include initiatives to prevent cardiac arrest by investigating preventable causes via autopsy or genomic analysis, and improving rehabilitation to enhance quality of life.[4,53] Furthermore, in an ageing society, it is crucial to discuss the options regarding the withdrawal of resuscitation. However, current registries face challenges in capturing these aspects due to difficulties in data collection. Another significant challenge is the workload associated with collecting in-hospital data. In many facilities across Japan, clinicians and administrators spend considerable time and effort to gather clinical data, a burden which may detract from their engagement in clinical research and contributions to registries. In an ideal scenario, medical data would be collected automatically in a standardised format, ensuring accuracy and completeness with minimal missing values, while not exacerbating the clinicians' burden of data collection and cleaning.

A potential solution lies in utilising Diagnosis Procedure Combination (DPC) data, which provides standardised, nationally consistent patient clinical information, including data related to medical procedures. These data are generated, compiled, and ultimately submitted to the Ministry of Health, Labour, and Welfare.[54,55] Leveraging DPC data could streamline the data collection and analysis processes. Some data points currently inputted manually into the OHCA Registry could be derived from DPC data. Additionally, the adoption of IT technology is a prospective solution. For example, optical character recognition systems could assist clinicians in recording clinical information in a standardised format using a smartphone camera.[56,57] Generative AI is also expected to be instrumental in extracting and summarising clinical data from electronic medical records.[58,59] Moreover, the development of a system to send short message service notifications for follow-up and collection of long-term outcomes is under consideration. These initiatives strive to advance the registry into the world's most comprehensive database for individual patient data.

Summary

This review discussed the registries collecting data for analysis concerning patients with OHCA in Japan. Each registry has differing philosophies, strengths, perspectives, and challenges. We anticipate that data from these registries will continue to be utilized to improve the quality of resuscitation, enhance patient outcomes, and contribute to resuscitation science. Through this review, OHCA registries in Japan are likely to become more widely recognized and lead to further international collaboration.

Ethical approval

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

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CRediT authorship contribution statement

Yohei Okada: Writing – original draft, Funding acquisition, Conceptualization. **Koshi Nakagawa:** Writing – review & editing, Writing – original draft, Conceptualization. **Hideharu Tanaka:** Writing – review & editing, Conceptualization. **Haruka Takahashi:** Writing – review & editing, Visualization, Conceptualization. **Tetsuhisa Kitamura:** Writing – review & editing, Writing – original draft, Conceptualization. **Takeyuki Kiguchi:** Writing – review & editing, Writing – original draft, Conceptualization. **Norihiro Nishioka:** Writing – review & editing, Writing – original draft, Conceptualization. **Nobuya Kitamura:** Writing – review & editing, Writing – original draft, Conceptualization.

Takashi Tagami: Writing – review & editing, Writing – original draft, Conceptualization. **Akihiko Inoue:** Writing – review & editing, Writing – original draft, Conceptualization. **Toru Hifumi:** Writing – review & editing, Supervision. **Tetsuya Sakamoto:** Writing – review & editing, Supervision. **Yasuhiro Kuroda:** Writing – review & editing, Supervision. **Taku Iwami:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization.

Declaration of competing interest

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Author details

[a]*Health Services and Systems Research, Duke-NUS Medical School, Singapore* [b]*Department of Preventive Services, Graduate School of Medicine, Kyoto University, Kyoto, Japan* [c]*Graduate School of Emergency Medical System, Kokushikan University, Japan* [d]*Medical Science, Nippon Sport Science University, Tokyo, Japan* [e]*Division of Environmental Medicine and Population Sciences, Department of Social and Environmental Medicine, Graduate School of Medicine, Osaka University, Osaka, Japan* [f]*Department of Emergency and Critical Care, Osaka General Medical Center, Osaka, Japan* [g]*Department of Emergency and Critical Care Medicine, Kimitsu Chuo Hospital, Kisarazu-shi, Chiba, Japan* [h]*Department of Emergency and Critical Care Medicine, Nippon Medical School Musashikosugi Hospital* [i]*Department of Emergency and Critical Care Medicine, Hyogo Emergency Medical Center, Hyogo, Japan* [j]*Department of Emergency and Critical Care Medicine, St. Luke's International Hospital, Tokyo, Japan* [k]*Department of Emergency Medicine, Teikyo University School of Medicine, Tokyo, Japan* [l]*Department of Emergency, Disaster and Critical Care Medicine, Kagawa University Hospital, Kagawa, Japan*

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