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Review

“1990 Suwa Seriya” the national pre-hospital care ambulance service of Sri Lanka; a narrative review describing the EMS system with special emphasis on Out of Hospital Cardiac Arrest (OHCA) in Sri Lanka



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Abstract

Background: Sri Lanka is a leading nation in healthcare provision in the South Asia. Notably, it recorded amongst the lowest maternal and neonatal mortality rates in the region. However a significant deficit in improving all-cause mortality rates was the absence of a cohesive system of pre-hospital care.

Method: This narrative review delves into the evolution of Sri Lanka's Emergency Medical Services (EMS) system over the past decade. It examines the historical context, challenges encountered, and the transformative role of the “1990 Suwa Seriya” ambulance service on all causes of morbidity and mortality rates including out-of-hospital cardiac arrest (OHCA).

Results: The review elucidates the path from no organised pre-hospital system in 2015 to a comprehensive free to public, pre-hospital care emergency ambulance service that effectively serves 22 million people nation-wide in 6 short years. Collaborations with emergency medicine, novel approaches to training and credentialing, as well as evolving research initiatives illustrate an approach to be emulated in countries with emerging pre-hospital systems. 1990 Suwa Seriya's response during the COVID-19 pandemic and its implications on public perception are discussed in conjunction with efforts to limit morbidity and mortality from OHCA.

Conclusion: In conclusion, the article underscores 1990 Suwa Seriya's dedication to continuous improvement and its potential as a model for bolstering emergency healthcare. By addressing challenges, fostering collaborations, and adapting to crises like the COVID-19 pandemic, 1990 Suwa Seriya exemplifies a pathway towards elevating pre-hospital care standards in lower-middle-income countries (LMICs).

Keywords: Resuscitation, Low resource, Pre-hospital care, Emergency medicine

Background

Sri Lanka, an island nation in South Asia, spans 65,625 km² and is categorized as a lower middle-income country (LMIC) with a population of approximately 22.1 million.^{1,2} The country boasts a comprehensive, universal healthcare system provided free to the public, encompassing a wide range of services including antenatal and child healthcare, vaccinations, and the prevention of both communicable and non-communicable diseases. Notably, Sri Lanka has been at the forefront within the South Asian region and among LMICs in

healthcare advancements, having successfully eradicated diseases such as malaria, polio, and neonatal tetanus. The nation reports a commendable female life expectancy of 78.6 years and maintains a maternal mortality rate (MMR) of 47 per 100,000 live births, a figure that stands as an outlier amongst lower middle income countries.^{1,2}

Coronary heart disease is the leading cause of mortality, with trauma, particularly from road traffic accidents, imposing a considerable burden on the healthcare system as the principal cause of hospitalization. World Bank data reveal that the nation experiences approximately 3,000 road fatalities and 8,000 severe injuries annually.^{3,4} Despite public health advancements, Sri Lanka's per capita

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road accident mortality rate stands at 17.4, which is twice that of high-income countries and the highest within the South Asian region.³ This alarming statistic calls for enhanced efforts and financial investment to augment emergency services within the national health budget.

The 2004 Boxing Day Tsunami was a pivotal event that exposed gaps in disaster response and emergency medical services (EMS), underscoring the need for effective and efficient pre-hospital care. The aftermath spurred a series of healthcare reforms, including the creation of a National Disaster Management Centre and the recognition of Emergency Medicine as a specialty in 2013. Additionally, 2016 saw the formulation of robust policies for pre-hospital care and accident and emergency services.^{1,4}

This narrative review seeks to delineate the evolution of the Sri Lankan EMS system over the past decade, scrutinizing future challenges and setting forth aspirations. It synthesizes available statistical data and incorporates the first-hand experiences of the authors within the EMS framework. Challenges and strategies for improving survival from OHCA are also examined.

The past

State of EMS before 2016

Before 2016, Sri Lanka's EMS faced significant logistical challenges. The predominant mode of emergency patient transport was the three-wheeled motorized rickshaw, colloquially termed 'Tuk Tuk'. These vehicles, while culturally emblematic, presented substantial barriers to effective patient transport including risks of secondary injuries during transit. The inefficiency of these transport methods contributed to delayed hospital arrivals, correlating with an increased rate of pre-hospital and in-hospital mortality, a common issue in LMICs.⁵ Despite efforts by various entities, including private and not-for-profit organizations past attempts to establish a reliable emergency ambulance network were largely unsuccessful.⁶

How 1990 Suwa Seriya was started

The key to the successful establishment of a pre-hospital system in Sri Lanka was a degree of financial security and broad political support.

The inauguration of the 1990 Suwa Seriya ambulance service was a significant stride in improving Sri Lanka's EMS capabilities, coinciding with the tenure of Ranil Wickremesinghe as Prime Minister. Dr. Harsha De Silva, the then Deputy Minister of National Policies and Economic Affairs, spearheaded the project. It received foundational support through a grant of \$7.55 million from the Indian government, marking the commencement of its first phase on July 28, 2016. This initial phase saw the deployment of 88 ambulances dedicated to serving the Southern and Western provinces, the establishment of an Emergency Command and Control Center, and provided for the operational costs for the initial year.⁵

Acknowledging the critical role of pre-hospital care in enhancing the populace's quality of life, the Sri Lankan Government institutionalized the service through the enactment of the 1990 Suwa Seriya Foundation Act No. 18 of 2018, on July 4, 2018, ensuring the program's sustainability beyond the Indian Government's grant.⁷

Further support from the Indian government, amounting to an additional \$15 million, launched the second phase on July 21, 2018. This extension enabled the acquisition of 209 additional ambu-

lances, culminating in a comprehensive fleet of 297 ambulances that expanded coverage to the entirety of the island.⁸

Collaboration with emergency medicine specialists in Sri Lanka

The Postgraduate Institute of Medicine (PGIM) at the University of Colombo began offering a Doctor of Medicine (MD) degree in Emergency Medicine in 2013. The Sri Lankan Society of Critical Care and Emergency Medicine (SSCCEM), which was founded in 2002, started to actively contribute to the education of emergency medicine and critical care in collaboration with Australian emergency physicians in 2006.⁹ By the inception of the 1990 Suwa Seriya service, the inaugural cohort of emergency medicine trainees were completing their local or overseas training, fulfilling the PGIM's curriculum requirements. Consequently, these trainees were appointed as on-call doctors and assisted with EMT training. Initially, each ambulance dispatch was meticulously coordinated with on-call emergency medicine specialists at the Emergency Command and Control Center in Colombo. To accommodate the increasing demand and ensure the service's secure expansion, the 1990 Suwa Seriya Foundation signed a memorandum of understanding (MOU) with the SSCCEM, fostering a sustained clinical governance partnership.⁶ With the formation of the Sri Lanka College of Emergency Physicians (SLCEP) in 2022, the torch of these educational and operational responsibilities was seamlessly passed on to SLCEP.

Initial training of staff

The selection process for Emergency Medical Technicians (EMTs) initially targeted individuals who had successfully completed their G.C.E Advanced Level education. In the program's formative years, the EMT candidates underwent a comprehensive two-month training curriculum in Hyderabad, India. This training encompassed a variety of educational components, including classroom instruction—high lighting Basic Life Support with AED and Intermediate Life Support (ILS) in line with American medical protocols. Additionally, they participated in simulation exercises, hospital-based training, and hands-on ambulance service in the Indian context, facilitated by the GVK Emergency Management and Research Institute (GVK EMRI). On their return to Sri Lanka, the EMTs completed a further four weeks focused on practical skill enhancement, communication proficiency, and familiarization with the local EMS protocols and healthcare regulations. This was complemented by a one-month in-field internship within the country.^{5,8}

Understanding the scope and priorities of the outsourced initial training program was crucial in molding future directions in practice and credentialing for the 1990 Suwa Seriya. A robust credentialing program facilitated rigorous maintenance of standards which impacted the acceptance of pre-hospital care by both the medical community and the general public.

Challenges during implementation

The integration of AEDs into ambulance services and routine defibrillation as part of advanced life support presented an unexpected obstacle. Despite limited numbers of publicly accessible AEDs in Sri Lanka, in locations where AEDs were available, such as airports, select hotels, and foreign embassies, usage was restricted to trained health and safety personnel on-site rather than the public. The exact number and placement of AEDs across the nation remain unrecorded¹⁰ as does their usage. The resistance to a treatment modality widely accepted in other parts of the globe, highlighted

the public naivety regarding the value of pre-hospital care as well as the increased survival from OHCA with early defibrillation.

In response to the lack of familiarity with pre-hospital care among the populace, a comprehensive public education campaign was initiated. This campaign utilized a multifaceted approach to engage the community, including television and print media campaigns, as well as direct outreach to various organizations. A key strategy involved 1990 Suwa Seriya representatives conducting educational sessions in schools. By teaching children the importance of calling 1990 during emergencies such as chest pain, and to encourage their parents to yield to ambulances in traffic, the initiative aimed to leverage the influence of the youth to disseminate these vital messages throughout their communities.¹¹ A public debate took place through the media regarding the evidence of the safety of pre-hospital defibrillation.

Rising with the COVID-19 waves

By mid-2019, the 1990 Suwa Seriya ambulance service had expanded its fleet to 297 vehicles and was supported by nearly 600 trained and credentialed EMTs. The service offered continuous nationwide coverage, facilitating prompt and expert emergency patient care. The onset of the COVID-19 pandemic marked a pivotal moment for the country and 1990 Suwa Seriya rose to the challenge, conducting the transfer of Sri Lanka's first COVID-19 patient.⁵

Throughout the pandemic, 1990 Suwa Seriya became a central pillar in the community response to COVID-19 infection waves, the few months before the pandemic, the service managed around 5,000 calls and 1,000 cases daily. As COVID-19 spread, these figures soared, with calls peaking at 9,000 daily and cases managed daily climbing to 1,500. EMTs received comprehensive training on the correct donning, doffing, and disposal of Personal Protective Equipment (PPE) to safeguard themselves while assisting potentially infected patients.⁵

The implications of transporting COVID-19 patients via public transport would have posed a grave risk of spreading the virus to the unvaccinated and susceptible members of the population. The steadfast commitment of 1990 Suwa Seriya was instrumental in curbing the spread of COVID-19, exemplifying its crucial role in protecting public health during the crisis. Thus the 1990 Suwa Seriya was cemented in public opinion as a crucial tenant of universal health care. Fig. 1 indicates the number of calls received during each month over the last 5 years.

The present

Operational procedures of the 1990 Suwa Seriya

The 1990 Suwa Seriya ambulance system operates with a fleet of 322 ambulances, staffed by nearly 600 EMTs. The public can reach the Emergency Command and Control Center (ECCC) via the toll-free number 1990 or through the 1990 mobile app, which offers the added benefit of geolocating the patient.⁵

The service's operations are under constant surveillance from the ECCC in Colombo. Factors such as response time (defined as the interval from when a case is assigned to an ambulance's departure) and adherence to authorized routes are diligently tracked alongside other critical performance metrics. Response times may vary across provinces due to varying factors like the nearest available ambulance, road conditions, and patient location. On average,

island-wide response times stand at approximately 12 min and 52 s, improving to 8 min and 32 s within the Colombo metropolitan region. See Fig. 2.⁵ The Average time from the scene to reach the hospital is also given in Fig. 2.

To date, 1990 Suwa Seriya has managed over 1.8 million incidents since 2016, with road traffic accidents comprising 26% and cardiac, stroke, or unconsciousness cases making up 38%. The average number of cases attended per month over the last year is indicated in Fig. 3.

1990 Suwa Seriya has proven its operational efficacy during significant emergency events, including building collapses, remote area bus accidents, floods, and notably, the "Easter Sunday" terrorist attacks in 2019 and multiple major Road Traffic accidents. In the wake of these simultaneous attacks on three churches and three luxury hotels, which resulted in over 500 injuries and 253 fatalities, 1990 Suwa Seriya's prompt and efficient medical response was instrumental in the crisis management.⁵

Operational procedures of out of hospital cardiac arrest

In Sri Lanka, the likelihood of receiving bystander CPR is notably low, mirroring the situation in other LMICs, where there are no established first responder programs or dispatcher-assisted CPR initiatives.¹² Ambulances are well-equipped with essential lifesaving equipment, including AED, adrenaline, IV cannulas, bag valve masks, and basic airway management equipments.

When EMTs reach the scene, they will continue CPR if it has been started by a bystander, connect the AED, and follow its instructions. The patient is then transferred to the closest hospital while receiving continuous manual CPR and ventilation. Any use of an AED mandates hospital transport. All critical patient information is currently recorded on a paper-based form, however a digital platform for improved documentation, clinical governance and research is planned to be implemented in the near future.

EMTs typically do not initiate CPR if the patient has been without resuscitation for over 15 min, suggesting a high likelihood of death. In these cases, the on-call emergency physician makes a judgment call on whether to start or discontinue CPR, based on the patient's medical history and the length of the arrest. At present, there's no unified database to track bystander CPR or survival rates accurately. A coordinated effort to amalgamate data from 1990 Suwa Seriya and hospital records is underway to better inform survival rates and the efficacy of interventions. This initiative is part of a larger research plan detailed in the forthcoming section on future strategies. Fig. 4 summarizes the process.

Current training and credentialing process

Local credentialing of skills in Basic Life Support (BLS), Advanced Life Support (ALS), airway management, and other essential areas was imperative to meet Sri Lanka's healthcare standards. Continuous case report documentation review became a part of 1990 Suwa Seriya's quality assurance measures and identified other areas for further development and staff education.

Educational materials were developed with insights from the Australia and New Zealand College of Paramedics and SSCCEM, resulting in four refresher training modules. These modules were revamped to include online components in Tamil, Sinhala, and English medium, supplemented by a one-day in-person course.⁶ The e-learning aspect encompassed a broad range of topics such as mass casualty management and scenario-based training covering

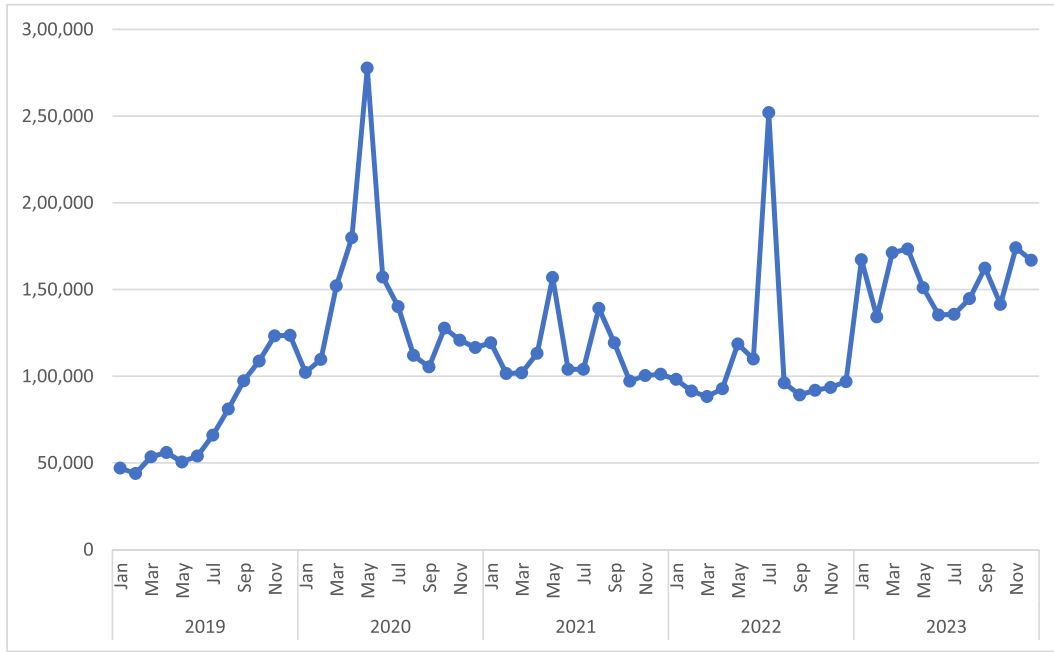


Fig. 1 - Number of calls received per month from 2019 to 2023.

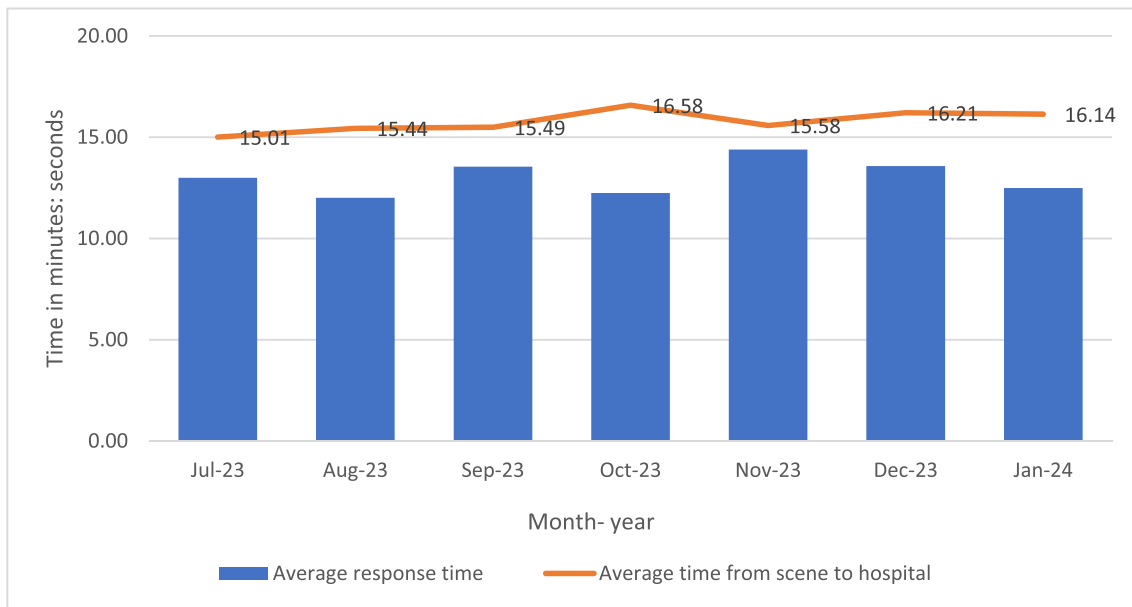


Fig. 2 - Average response time of the ambulance service from assigning of an ambulance to reaching the scene and average number of cases attended by the EMS 1990 Suwa Seriya from July 2023 to January 2024.

obstetrics, pediatrics, toxicology, and sepsis, while the in-person sessions focused on BLS, trauma care, emergency childbirth, and newborn resuscitation skills.

This blend of online and practical training not only upheld service quality but also enabled workforce stratification, identifying candidates for an advanced tier of extended-care EMTs.

The development of the Diploma in Paramedical Sciences for Emergency Medical Technicians was meticulously aligned with local and international pre-hospital care standards. The program was developed through a collaboration between the Faculty of Medicine

at the University of Kelaniya, Sri Lanka College of Emergency Physicians, and the 1990 Suwa Seriya Foundation.

The first cohort of recruited EMTs is now engaged in a specialized program at the University of Kelaniya’s Faculty of Medicine. Upon successful completion, they will receive the Advanced Certificate in Paramedical Sciences, designed specifically for Sri Lanka’s EMS. The curriculum is divided into theoretical and practical clinical training, including rotations in Accident & Emergency (A&E), obstetrics, ambulance service, and psychiatry. Successful clinical assessments qualify trainees for certification as recognized EMTs.

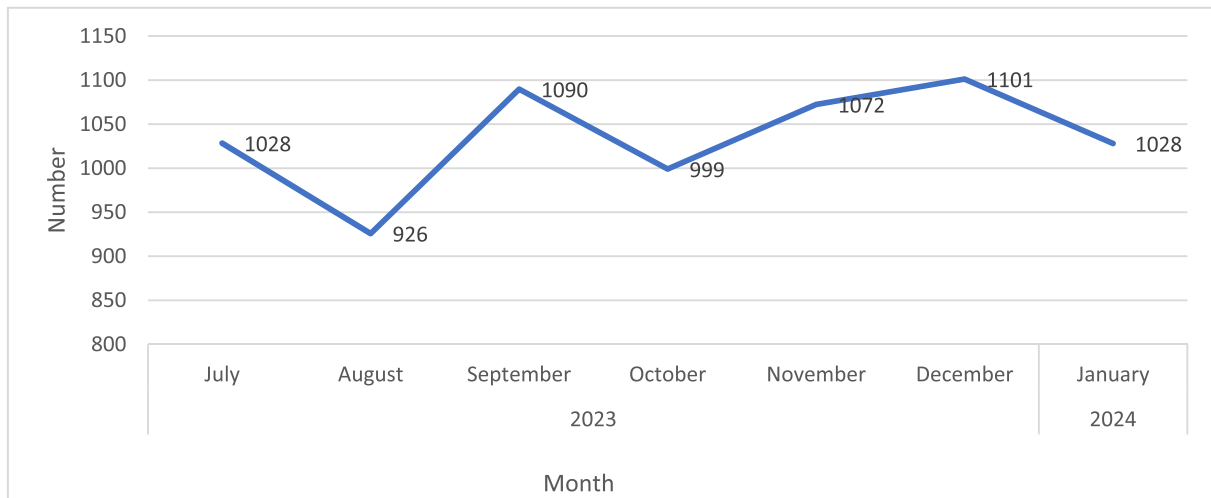


Fig. 3 – Average number of cases attended per month by Suwa Seriya from July 2023 to January 2024.

Research in pre-hospital care and OHCA

The 1990 Suwa Seriya ambulance initiative, stands as the sole provider of a free ambulance service on a national scale within a country classified as a LMIC.¹³ This unique model provides an unparalleled opportunity to contribute significantly to the scientific body of knowledge in pre-hospital care for LMICs.

According to the World Health Organization (WHO), about 80% of global emergencies occur in developing nations, where EMS services are often inadequate. The WHO recommends the development of EMS systems in LMICs, and 1990 Suwa Seriya's model provides a valuable case study for assessing the economic impacts on implementing EMS healthcare systems in developing countries.¹⁴

In pursuit of advancing OHCA research, the Sri Lanka Out-of-Hospital Cardiac Arrest Study (SLOCAS) was initiated. Inspired by the EuReCa 2 study, SLOCAS aims to collect selected data of Utstein template on OHCA cases attended by 1990 Suwa Seriya during a selected period of time. Additionally, it seeks to establish a pilot research framework that could lead to a comprehensive OHCA registry for LMICs.

With the commencement of the robust Electronic Patient Care Record (ePCR) system, 1990 Suwa Seriya is set to make significant contributions to pre-hospital care research in LMICs. This forward-thinking approach demonstrates the service's dedication to improving healthcare outcomes and fostering transformative change in the healthcare sector of Sri Lanka and other LMICs.

Current perception of the public

The 1990 Suwa Seriya ambulance service has garnered substantial popularity and is now regarded as an indispensable public service. While it is accessible free of charge to all, including both Sri Lankan citizens and foreign nationals, there exists a need for heightened public awareness.

Insufficient awareness about the role of coordinated pre-hospital EMS services can lead to reluctance in calling for an ambulance or yielding the right of way when an ambulance with flashing beacons approaches. Moreover, knowledge of essential first aid and bystander CPR is pivotal for effective prehospital care.

In recognition of these imperatives, 1990 Suwa Seriya actively participated in "World Restart Heart Day" in 2019, aligning with this global initiative's objective to promote bystander CPR and the swift transportation of patients to hospitals.

Promoting the practice of giving way to ambulances on the road is a crucial aspect of enhancing emergency medical services. This change in behavior among the public represents a significant step forward in ensuring the swift and unhindered movement of ambulances during critical situations. It not only contributes to reducing response times but also plays a vital role in saving lives. There is an ongoing effort to educate and encourage the public to yield the right of way to ambulances through print and broadcast media as well as direct engagement with schools and social entities.

The future

The core of 1990 Suwa Seriya's mission and vision is distilled into a powerful and succinct tagline displayed on every ambulance: "Save a Life". The organization is dedicated to realizing this mission by fostering a culture of continuous innovation grounded in evidence-based practices. Efficient stewardship of funds from donors and taxpayers is also a top priority. As a result, 1990 Suwa Seriya is actively pursuing a range of exciting new developments as well as cementing existing innovations of proven benefit.

Overall operations

1990 Suwa Seriya is in the process of replacing manual Patient Care Reports with electronic versions, not only reducing the environmental impact by minimizing paper usage but also elevating the precision of information capture. Additionally, this digital transformation empowers in-depth data analysis through a sophisticated business intelligence system.

1990 Suwa Seriya's leadership is in active collaboration with local and international donors to augment the ambulance fleet to a total of 450 vehicles. This expansion is aimed at achieving an all-island average response time of less than 8 min, thereby guaranteeing rapid and efficient emergency responses.

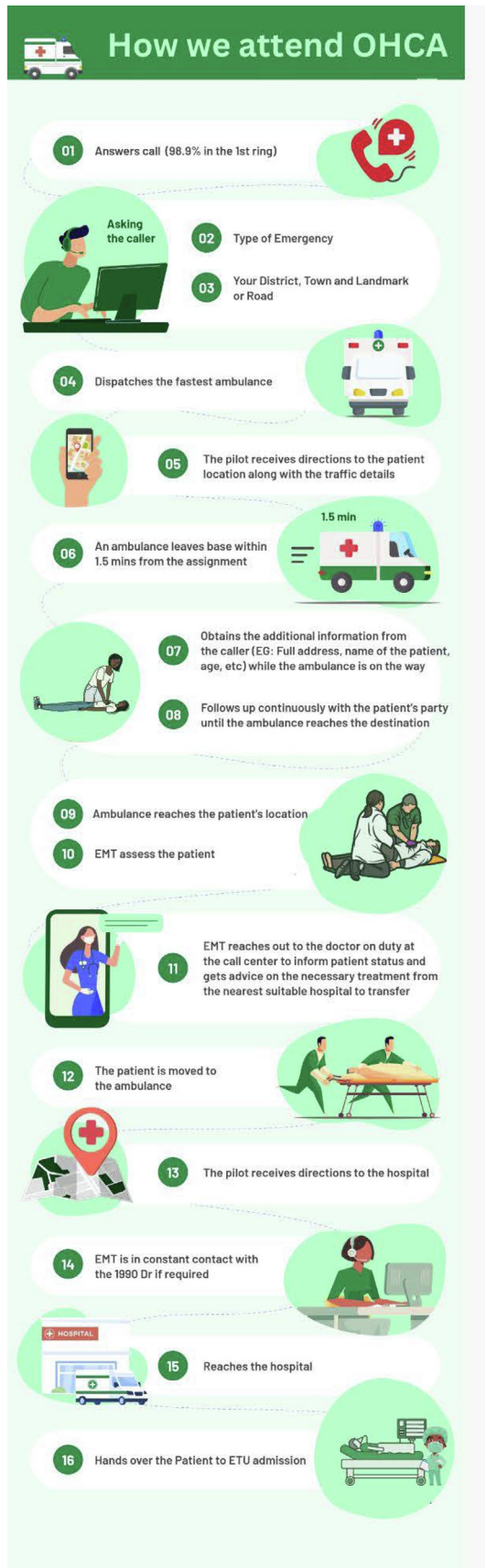


Fig. 4 – Process of handling out of hospital cardiac arrest by Suwaseriya Ambulance Service. ETU Emergency Treatment Unit of the Hospital.

The introduction of connected ambulances will establish seamless communication between ambulance teams and Emergency Physicians at the ECCC. This innovation will ensure real-time support and guidance through telemedicine, further improving the quality of care provided to patients.

Out-of-hospital cardiac arrest care improvement

1990 Suwa Seriya has established a partnership with the Sri Lanka College of Cardiologists to implement the utilization of 12-lead ECGs and facilitate the transmission of data to cardiac catheterization labs. This initiative is set to enhance cardiac care significantly, allowing for the direct transportation of STEMI patients to hospitals equipped with



Fig. 5 – Summary of key determining factors for sustainability of EMS service in Sri Lanka.

catheterization labs when it is deemed appropriate including post resuscitation.

1990 Suwa Seriya is preparing to train Advanced Care EMTs who will be equipped with advanced skills including advanced airway management and an expanded formulary. This strategic move is aimed at elevating the level of care provided and ultimately leading to improved patient outcomes.

The service is actively exploring opportunities to acquire mechanical chest compression devices to enhance the quality of care provided during cardiopulmonary resuscitation (CPR) during transport. However, these are currently deprioritized due to financial limitations.

1990 Suwa Seriya is actively planning to enhance its dispatcher-assisted CPR services. This improvement will involve both dispatch and remote support to guide bystanders in providing CPR effectively. Additionally, the organization recognizes the importance of educating the public, particularly school children, about pre-hospital services and the chain of survival for OHCA cases and other urgent medical emergencies through the "1990 Education in Schools" program.

1990 Suwa Seriya acknowledges the need for community education programs focusing on basic CPR and resuscitation techniques. These programs will be crucial as the community becomes more familiar with the use of AEDs. Developing OHCA management within the community involves increasing the proportion of the public who are willing and able to provide chest compressions and use AEDs until the arrival of 1990 Suwa Seriya's emergency services.

These developments demonstrate 1990 Suwa Seriya's unwavering commitment to advancing its services and saving lives through continuous improvement and strategic partnerships. Fig. 5 summarizes the key factors that contributed to the EMS system in Sri Lanka.¹⁵

In just seven short years, 1990 Suwa Seriya brought about a revolutionary transformation in the Sri Lankan prehospital care service. Through the introduction of innovative protocols and a substantial digital transformation of operational management, this service has not only decreased all-cause morbidity and mortality but also paves the way for a brighter future in acute healthcare provision.

Although the determinant of success is multifactorial, the strong and sustained government support and national policy of universal free healthcare and education have been a key driving force for the remarkable achievements of this service.

The success achieved by 1990 Suwa Seriya showcases its potential to continue thriving and making a profound impact on countless lives in the years to come. Furthermore, it stands as a shining example and a model for similar prehospital systems in other developing countries, demonstrating the possibilities of modernizing and improving emergency medical services on a global scale.

CRedit authorship contribution statement

Kaushila Thilakasiri: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Conceptualization. **P.K.I. Wijegunawardana:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Sohan de Silva:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Sanj Fernando:** Writing – review & editing, Writing – original draft, Visualization, Formal analysis, Conceptualization. **Sri Lal De Silva:** Writing – review & editing, Writing – original draft, Supervision, Formal analysis.

Declaration of competing interest

Sri Lal De Silva is the Chief Medical Officer and Sohan de Silva is the Chief Executive Officer of 1990 Suwa Seriya Foundation.

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