


# Methodological analysis of a community-based training initiative using the EPIS framework: an ongoing initiative to empower 10 million bystanders in CPR and bleeding control

Asma Altaf Hussain Merchant <sup>1</sup>, Sheza Hassan,<sup>2</sup> Noor Baig,<sup>2,3</sup> Huba Atiq,<sup>2,3</sup> Sana Mahmood,<sup>4</sup> Ann Doll,<sup>5</sup> Rizwan Naseer,<sup>6</sup> Zia Ul Haq,<sup>7</sup> Deeba Shehnaz,<sup>6</sup> Adil H. Haider,<sup>1,8</sup> Junaid Razzak<sup>2,9</sup>

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<sup>1</sup>Dean's Office, The Aga Khan University, Karachi, Sindh, Pakistan

<sup>2</sup>Centre of Excellence for Trauma and Emergencies, The Aga Khan University, Karachi, Sindh, Pakistan

<sup>3</sup>Department of Emergency Medicine, The Aga Khan University, Karachi, Sindh, Pakistan

<sup>4</sup>CITRIC Health Data Science Center, The Aga Khan University, Karachi, Sindh, Pakistan

<sup>5</sup>Resuscitation Academy Foundation, Seattle, Washington, USA

<sup>6</sup>Rescue 1122, Lahore, Punjab, Pakistan

<sup>7</sup>Department of Public Health, Khyber Medical University, Peshawar, Pakistan

<sup>8</sup>Department of Surgery and Community Health Sciences, The Aga Khan University, Karachi, Sindh, Pakistan

<sup>9</sup>Department of Emergency Medicine, Weill Cornell Medicine, New York, New York, USA

## Correspondence to

Dr Asma Altaf Hussain Merchant; asma.altafmerchant@gmail.com

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## ABSTRACT

**Background** Out-of-hospital cardiac arrest (OHCA) and life-threatening bleeding from trauma are leading causes of preventable mortality globally. Early intervention from bystanders can play a pivotal role in increasing the survival rate of victims. While great efforts for bystander training have yielded positive results in high-income countries, the same has not been replicated in low and middle-income countries (LMICs) due to resources constraints. This article describes a replicable implementation model of a nationwide program, aimed at empowering 10 million bystanders with basic knowledge and skills of hands-only cardiopulmonary resuscitation (CPR) and bleeding control in a resource-limited setting.

**Methods** Using the EPIS (Exploration, Preparation, Implementation and Sustainment) framework, we describe the application of a national bystander training program, named 'Pakistan Life Savers Programme (PLSP)', in an LMIC. We discuss the opportunities and challenges faced during each phase of the program's implementation and identify feasible and sustainable actions to make them reproducible in similar low-resource settings.

**Results** A high mortality rate owing to OHCA and traumatic life-threatening bleeding was identified as a national issue in Pakistan. After intensive discussions during the exploration phase, PLSP was chosen as a potential solution. The preparation phase oversaw the logistical administration of the program and highlighted avenues using minimal resources to attain maximum outreach. National implementation of bystander training started as a pilot in suburban schools and expanded to other institutions, with 127 833 bystanders trained to date. Sustainability of the program was targeted through its addition in a single national curriculum taught in schools and the development of a cohesive collaborative network with entities sharing similar goals.

**Conclusion** This article provides a methodological framework of implementing a national intervention based on bystander response. Such programs can increase bystander willingness and confidence in performing CPR and bleeding control, decreasing preventable deaths in countries having a high mortality burden.

**Level of evidence** Level VI.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Bystander training has shown to empower non-medical personnel in taking immediate action for provision of cardiopulmonary resuscitation (CPR) and bleeding control, specifically in high-income countries. This has led to a significant decrease in the burden of mortality secondary to cardiac arrest and life-threatening bleeding; however, similar initiatives have not been developed in low-resource settings which face a higher burden.

## WHAT THIS STUDY ADDS

⇒ While low and middle-income countries have limited resources and expertise, a structured program could be developed using methodological frameworks and proper planning to provide basic life-saving skills of CPR and bleeding control to bystanders.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study provides a novel bystander training initiative using the EPIS (Exploration, Preparation, Implementation and Sustainment) framework that could be replicated in low-resource settings to empower bystanders in basic life-saving skills. This also provides a template to stakeholders in healthcare to develop policies encouraging such initiatives within their countries.

## INTRODUCTION

Injuries and sudden death due to cardiac arrest contribute to 9% and 15% of global mortality, respectively, with the low and middle-income countries (LMICs) experiencing majority of this burden.<sup>1 2</sup> While out-of-hospital cardiac arrest (OHCA) remains a major challenge with a global incidence of 55 per 100 000 person-years,<sup>3</sup> injuries are expected to become the third leading cause of death by 2030.<sup>4</sup> Survival from both highly depends on immediate resuscitation and initiation of the chain of survival.<sup>5</sup> However, application of the survival chain varies in different parts of the world, hence posing a challenge to reducing the mortality burden.

Every minute that passes by without initiating cardiopulmonary resuscitation (CPR) after OHCA decreases the likelihood of survival by 10–12%.<sup>6</sup> Since more than 50% of cardiac arrest occurs outside the hospital, immediate intervention is required for a positive outcome.<sup>7</sup> Development of robust prehospital set-up in high-income countries (HICs) has increased the overall survival for OHCA from 0% to 40%.<sup>8</sup> However, scarcity of emergency medical services (EMS) and regional variation in LMICs continue to have adverse results.<sup>9</sup> A multicenter study conducted in Pakistan shows a 1.6% survival rate post-OHCA at discharge from emergency department (ED), which then dropped to 0% at 2-month follow-up.<sup>10</sup> Multifaceted causes for these poor results include delayed intervention, non-responsive bystander, and malfunctioning EMS.<sup>10</sup>

Penetrating wounds, blunt trauma, and injuries from shearing forces can also lead to life-threatening bleeding.<sup>11</sup> Absence of timely treatment in these cases can result in a mortality rate of up to 50%,<sup>11</sup> more than half of which could be prevented with adequate hemorrhage control by bystanders.<sup>12</sup> In LMICs, trauma alone leads to an estimated mortality of 90%, with 80% of them occurring in a prehospital setting,<sup>13</sup> having twice the odds of mortality as compared with HICs.

Where prehospital system fails to provide timely intervention, an impact can be created through bystanders at the scene. Literature shows that bystander CPR and bleeding control can improve the prehospital survival in patients.<sup>14 15</sup> However, LMICs have a weak chain of survival due to underdeveloped EMS system and lack of bystander response in critical situations.<sup>16</sup> Bystander's role in performing CPR and first aid highly depends on their prior training experiences.<sup>17 18</sup> To increase the knowledge and self-efficacy of bystanders in performing CPR and bleeding control, there is a need of public training which can cause positive ripples within prehospital care and improve survival.

With this notion, a sustainable and resource-friendly nationwide program was introduced in Pakistan, a developing country, to empower its citizens in the basic life-saving skills of CPR and bleeding control. Success of such large-scale interventions depends on a combination of multitiered factors, especially in a low-resource setting. Thereby, this article aims to use the Exploration, Preparation, Implementation and Sustainment (EPIS) framework to describe the feasible and sustainable application of Pakistan Life Savers Programme (PLSP) in a resource-limited setting (RLS).

## METHODOLOGY

### Study setting

Classified by the World Bank as an LMIC,<sup>19</sup> Pakistan has a population of more than 225 million people, making it one of the top 10 largest countries globally.<sup>20</sup> According to Global Burden of Disease 2010 data for Pakistan, non-communicable diseases and injuries amount to 77% of age-standardized deaths.<sup>21</sup> Projection of these data from 2010 to 2025 estimated the crude yearly mortality per 100 000 population to increase from 125.5 to 144.4 for cardiovascular diseases and from 10.7 to 14.5 for road traffic accidents.<sup>21</sup> While there are multiple hospitals across the country, lack of funding and public–private partnerships limits the development of its healthcare system.<sup>22</sup> Differences in availability and quality of EMS further add to this national burden. As a means to empower bystanders to take action during such situations, PLSP was introduced as a national interventional strategy aimed to enable citizens of a resource-constraint country with basic life-saving skills.<sup>23</sup>

### In-depth overview of PLSP methodology

PLSP's mission is to equip 10 million citizens of the country with knowledge and skills required to perform CPR and bleeding control during a period of 10 years. It targets to achieve its goal through training sessions which incorporates simplified knowledge and skills using the American Heart Association (AHA) guidelines.

Multiple frameworks have been developed and validated as a tool to analyze implementation science models globally.<sup>24</sup> To identify the most efficient framework describing the process of PLSP design and implementation, a series of internal discussions took place between the PLSP leadership and its affiliated stakeholders. Top three frameworks to describe implementation science models were discussed, namely EPIS, PRISM (Practical, Robust Implementation and Sustainability Model) and CFIR (Consolidated Framework for Implementation Research). A robust analysis was done focusing on each framework's aim, individual components, distinguishing features, and its applicability to PLSP. This led the team to select EPIS as the most practical guide to comprehensively describe implementation of PLSP from its initiation to sustainment.<sup>25</sup>

Figure 1 demonstrates a summary of each phase of the EPIS framework from PLSP's perspective. Application of this framework within the PLSP model enabled constant review of outcomes at each phase and highlighted the areas where further changes were required for success. As a guide to implementation science programs for national level application, a checklist has been provided with step-by-step specific pointers (online supplemental material).

### Phase 1: exploration

Evidence from previously published literature in Pakistan had identified the clinical need of improving prehospital care to decrease preventable mortality from OHCA and life-threatening bleeding. Results from these studies led to the creation of PLSP as a solution to decrease the morbidity and mortality secondary to both.

### Inner context

Personal motivation is a strong driver for the implementation of system-changing interventions. Healthcare leadership of emergency medicine (EM) from Pakistan's largest academic medical center (AMC) identified this gap based on their personal and professional experiences and formed a group to work toward bystander empowerment in basic life-saving skills. These group members were identified over a series of discussions led by PLSP founders among EM practitioners of the AMC. The discussions mainly included highlighting the aim of intervention and identifying interested people who would lead the initiative without any financial incentive. Further expansion of this team was done in later phases to include representatives involved with each stage of the chain of survival. The PLSP founders had previously published studies from Pakistan indicating a high mortality rate due to the two identified causes. The first study revealed an estimated annual OHCA incidence in Karachi, the most populous city of Pakistan, to be 166 per 100 000 population.<sup>26</sup> The study focusing on trauma-related injuries identified them to be among the top 10 contributors to the country's disease burden.<sup>27</sup> Since these injuries majorly affect younger population who are often bread earners of the family, it increases the social and economic burden on both individual and the society.<sup>27</sup> Lack of resources and infrastructure in such a low-resource country further adds to this issue.

Hence, PLSP was founded to incorporate treatment approaches to the two most common, yet devastating, conditions faced by the citizens of Pakistan. While undergoing this process, a structured leadership was established, along with the formation of a secretariat within the Centre of Excellence for Trauma and Emergencies (CETE) at the AMC. This department is mandated to work toward development of research opportunities and capacity building in trauma and health emergencies. Hence, it proved to be a strong institutional support to the mission of PLSP.

To select an appropriate intervention as part of PLSP, multiple meetings between the stakeholders were conducted, who majorly included the CETE secretariat and PLSP founders at this time. Discussions and research revealed an existing set-up of disparate bystander CPR and bleeding control training sessions by various organizations. Majority of these sessions are being held by consultancy companies where the trainers are claimed to be accredited by MEDIC USA (MEDIC First Aid International), IOSH UK (Institute of Occupational Safety and Health), etc.<sup>28 29</sup> This leads to a lack of standardized content within the trainings. Furthermore, while some of these trainings provide one-on-one and group sessions, its cost ranges from \$35 to \$60 per person, which is not affordable for majority of the population. Thereby, PLSP was confirmed as a common platform to bring stakeholders together and develop a high-quality, free-of-cost, nationwide program to train bystanders in CPR and bleeding control.

**Outer context**

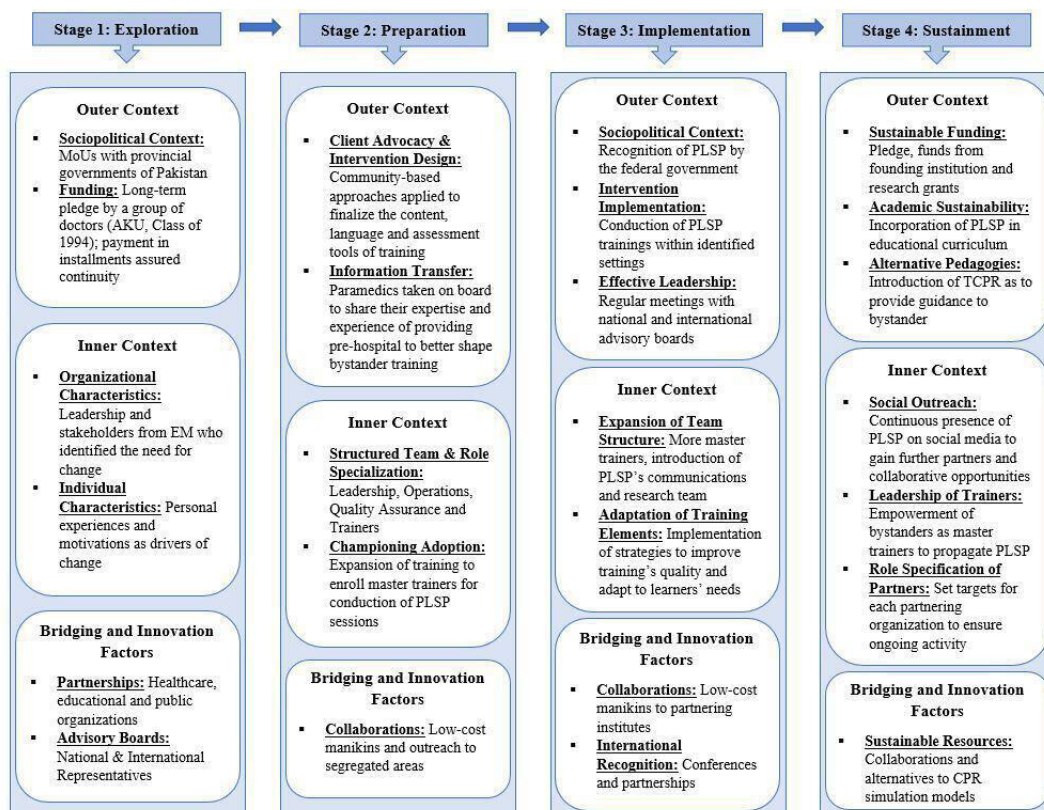
The clinical need identified from literature provided the foundation to receive political and financial support. Since it was

often difficult to engage political entities, various avenues were explored. Governmental leadership was mainly attracted through representatives of public emergency rescue services—this involved leaders of ambulance services who reached out to their provincial departments of health for action. Further discussions with these political leaders were conducted to provide a sense of ownership, leading to public–private collaborations.

The AMC has a strong alumni network, with graduates pursuing successful careers in different parts of the world. A group of well-established alumni closely affiliated with the PLSP founders recognized the continuous efforts of the team and pledged sustained funding for this initiative which could be used for PLSP training sessions, equipment, and outreach. These alumni were primarily attracted through formal presentations by the PLSP founders which gave an in-depth overview of where the funds will be used. The credibility of the AMC and founders further made acquiring the funds easier. Initially, country’s youth (30% of the population aged 10–24) was selected as the main target audience for PLSP by the stakeholders due to their invigorating passion of change and access to a multitude of convenient avenues (education, healthcare institutions, etc).<sup>30</sup>

**Bridging and innovation factors**

Focusing on the target population, academic partners were identified to include educational institutions catering to students of primary level and beyond. Since there are various education systems running parallel to each other, major focus was given to governmental institutions, religion-centered schools (madrassas) and a few private organizations affiliated with the AMC’s network of institutions. Healthcare institutions were also recognized to further increase the extent of the program.



**Figure 1** A summary of Pakistan Life Savers Programme’s (PLSP) methodology using Exploration, Preparation, Implementation and Sustainment (EPIS) framework. AKU, Aga Khan University; CPR, cardiopulmonary resuscitation; EM, emergency medicine; MoU, memorandum of understanding; T CPR, telephone-assisted CPR.



These included ambulance systems and public hospitals which were working toward a similar goal. While no financial incentive was provided, previously gained governmental support and having credible board members with extensive leadership reach proved pivotal to expand academic and healthcare-affiliated partnerships.

During this phase, members were also identified for PLSP's international and national advisory boards. The selection process ensured that these leaders hold similar interests as PLSP, had prior experience of working in such capacities and have resources for expansion of the idea. Furthermore, pedagogies were explored by the leadership to disseminate PLSP's mission within the country, in keeping with the diverse socioeconomic and educational background of the population.

### Phase 2: preparation

During this stage, potential barriers were identified for PLSP implementation and strategies were procured to resolve them.

#### Inner context

To facilitate PLSP, a formal team was made where each individual's role was recognized according to their capabilities. This team included founders of PLSP, operations/monitoring team which oversaw the implementation of training sessions, quality assurance team which ensured standard content delivery and a team of trainers who were responsible for the conduction of trainings. This team of trainers was spearheaded by two lead trainers who were well versed in prehospital care and had prior experience of providing CPR and bleeding control at community levels.

During this phase, the leadership, along with the operations team, used reliable resources such as AHA and Stop the Bleed (STB) to develop a curriculum for imparting PLSP's objectives.<sup>31 32</sup> An initial curriculum was designed by the internal team which was finalized after several discussions. Furthermore, evaluation tools were also discussed among the leaders to ascertain the delivery of their aim through PLSP. Evaluation strategies included a formative arm (practice and question/answer session within the training) and summative arm (pre-evaluation and post-evaluation surveys and post-training hands-on skills assessment).

Train-the-trainer model was used to prepare a team of instructors (including master trainers and submaster trainers) who would conduct PLSP trainings. These voluntary instructors were individuals affiliated with healthcare institutions who were interested in being a part of PLSP's national cause without any monetary benefit. Induction of an individual as a master trainer occurred after they underwent the following process:

- ▶ Participation in an introductory PLSP session, where they were taught the basics of CPR and bleeding control as bystanders.
- ▶ Attendance in a Master Trainer Course which introduced them to pedagogies required for teaching CPR and bleeding control in PLSP sessions to bystanders.
- ▶ Conduction of two PLSP training sessions for bystanders under observation of lead trainers.
- ▶ Submission of a report after conducting their first unsupervised PLSP session to share their experience, including barriers and facilitators faced during the session.

Initially, a group of 8–10 master trainers were prepared by the lead trainers for the conduction of PLSP sessions. These master trainers then tutored leaders from training sites, such as schools, to create submaster trainers, who conducted local teaching sessions for bystanders to produce life-savers. During this

process, the values and commitment of master and submaster trainers toward PLSP were also assessed which aided in understanding their motivations of being a part of PLSP. This ensured enrollment of passion-driven individuals for the project's sustainability.

#### Outer context

Continuous efforts were undertaken to develop partnerships with political, educational, and other healthcare forums to expand PLSP. Memorandums of understanding were signed with provincial governmental bodies of Pakistan to initiate synergistic collaborations. This strengthened government support and encouraged policy development for integration of PLSP within organizations. The policy focused on during this phase was to advocate for bystander protection law, commonly known as the Good Samaritan Law. While one of the provinces had a pre-existing Emergency Services Act, it only protected medical and rescue workers.<sup>33</sup> Therefore, discussions were conducted to encourage bystanders to take an active role during emergencies such as OHCA and life-threatening bleeding, without the fear of any legal issues arising. Paramedics were also taken on board for their expertise in evaluating whether the developed strategies were adequate to teach bystanders basic life-saving skills.

Within this phase, the national and international advisory boards were responsible to provide oversight and direction to expand the objective of PLSP productively. Thereby, they aided in finalizing the curriculum and identifying organizations that could further support PLSP's cause. To ensure the curriculum's understanding from a community context, the content was simplified and developed in Urdu, the most understood and spoken language of Pakistan. This ensured maximum outreach within the population. The finalized curriculum was then validated by the Department of Educational Development (DED) at the AMC (table 1). For validation, the DED team was provided with its first draft which was discussed during two to three of their internal team meetings. The feedback was then shared with PLSP's core team in the form of a report. The final curriculum was then reviewed and approved by selected DED representatives.

As a means to teach PLSP's curriculum to youth on a large scale, discussions were generated to incorporate it as part of educational teaching in schools and colleges. For this purpose, governmental and private schools affiliated with the AMC's network were prioritized since their representatives already had partnerships with PLSP. Further discussions focused on content, logistics and tasks which needed to be done to achieve this mandate.

#### Bridging and innovation factors

Adequate equipment was arranged before the conduction of the trainings. This was made possible after forming partnerships with agencies that produced low-cost simulation manikins. Furthermore, strategies were devised to reach out to people earning below the poverty line and living in suburbs. These included reaching out to representatives of low-income communities/areas and forming collaborations with a not-for-profit organization which provided education to less privileged children of the society. Since the main aim of this organization was to bring positive social change within the country through education, its leaders were invigorated to provide CPR and bleeding control training to the students. Taking advantage of its wide network across the country, segregated areas were also targeted to disseminate

**Table 1** PLSP curriculum for bystander training in CPR and bleeding control

	Component	Teaching pedagogy	Time duration (min)								
Section A: introduction of PLSP	Introduction and rationale of PLSP	PowerPoint presentation, succeeded by a video* incorporating the following domains: <ul style="list-style-type: none"> <li>▶ Current burden of cardiac arrest and severe post-traumatic bleeding in Pakistan.</li> <li>▶ Role of bystanders in these emergency situations.</li> <li>▶ Objectives of PLSP and creation of life-savers as a potential solution to this issue.</li> </ul>	5								
Section B: response to emergency situations	Initial response as a bystander in an emergency situation dealing with cardiac arrest/severe bleeding	A video highlighting the dos and don'ts as a bystander: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Dos</th> <th style="text-align: left;">Don'ts</th> </tr> </thead> <tbody> <tr> <td>Ensure scene safety.</td> <td>Do not step up before affirming your safety.</td> </tr> <tr> <td>Call an ambulance.</td> <td>Do not be a passive observer.</td> </tr> <tr> <td>Relevant information for relay to the ambulance service.†</td> <td>Do not waste time in capturing visuals of the scene.</td> </tr> </tbody> </table> Participants are then engaged through use of examples and gauging their initial response of action.	Dos	Don'ts	Ensure scene safety.	Do not step up before affirming your safety.	Call an ambulance.	Do not be a passive observer.	Relevant information for relay to the ambulance service.†	Do not waste time in capturing visuals of the scene.	10
Dos	Don'ts										
Ensure scene safety.	Do not step up before affirming your safety.										
Call an ambulance.	Do not be a passive observer.										
Relevant information for relay to the ambulance service.†	Do not waste time in capturing visuals of the scene.										
Section C: CPR	Preconceived notions of participants regarding CPR	Verbal discussion to engage participants and determine their preconceived notions.	5								
	Basic information of the process of CPR delivery	<ul style="list-style-type: none"> <li>▶ A video demonstrating an example of cardiac arrest and initial response of a bystander incorporating CPR.</li> <li>▶ Step-by-step demonstration of proper bystander response to cardiac arrest as follows:               <ul style="list-style-type: none"> <li>'Shake &amp; Shout' to ascertain response of the patient.</li> <li>'Call for Help' using the number of any ambulance service.</li> <li>'Check for Breathing' by looking at his/her chest's movement.</li> <li>'Start Chest Compressions' if no sign of breathing until help arrives/patient responds.</li> </ul> </li> </ul>	10								
	Details of appropriate delivery of quality CPR	<ul style="list-style-type: none"> <li>▶ A video demonstrating proper hand and body positioning of bystander while providing CPR.</li> <li>▶ In-person demonstration with explanation of all steps of CPR by a master trainer on a manikin.</li> <li>▶ Verbal repetition of all steps while emphasizing on when to stop CPR.</li> <li>▶ Short Q/A session to answer all queries of the participants.</li> </ul>	15								
Section D: bleeding control	Preconceived notions of participants regarding bleeding control	Verbal discussion to engage participants and determine their preconceived notions.	5								
	Basic information of the process of bleeding control	<ul style="list-style-type: none"> <li>▶ A video demonstrating an example of severe bleeding and initial response of a bystander in such a situation.</li> <li>▶ Step-by-step demonstration of proper bystander response to severe bleeding as follows:               <ul style="list-style-type: none"> <li>'Check for Response'; if none, then check breathing status.</li> <li>'Call for Help' using the number of any ambulance service.</li> <li>'Check for Bleeding Site' after covering your own hands.</li> <li>'Provide Direct Compression' on the bleeding site using a clean cloth for at least 10 min.</li> <li>'Perform Wound Packing' if the wound is deep.</li> </ul> </li> </ul>	10								
	Details of appropriate bleeding control	<ul style="list-style-type: none"> <li>▶ In-person demonstration with explanation of all steps of bleeding control by a master trainer using a manikin.</li> <li>▶ Verbal repetition of all steps of bleeding control.</li> <li>▶ Short Q/A session to answer all queries of the participants.</li> </ul>	15								
Section E: implication of COVID-19	Safeguarding oneself from COVID-19	A video highlighting strategies on how to decrease spread of COVID-19 while helping patients with cardiac arrest/severe bleeding.	5								
Section F: practical demonstration and assessment	Proper application and practice of skills	<ul style="list-style-type: none"> <li>▶ Provision of 2 min practice for each participant on a manikin using metronome for CPR.</li> <li>▶ Assessment of skills of each participant using their response to a hypothetical situation on a manikin.</li> </ul>	40								

\*Video used in PLSP sessions is audio recorded in Urdu with English subtitles available for convenience of understanding of the participants.  
 †This includes contact information of the caller, location of the emergency (mentioning a famous landmark if applicable), age of the patient, chief complaint, status of patient's consciousness and breathing.  
 CPR, cardiopulmonary resuscitation; PLSP, Pakistan Life Savers Programme; Q/A, question/answer.

PLSP curriculum among these communities. Furthermore, continuous presence on social media of PLSP's endeavors led leadership of other communities (transgender, religious minorities, etc) to reach out with requests to conduct PLSP sessions for their participants.

### Phase 3: implementation

After sufficient preparation, PLSP training sessions were first conducted as a pilot within suburban schools to assure understanding of the content. Successful implementation of

the pilot sessions encouraged expansion of PLSP trainings to other targeted educational and healthcare institutions. Since inception, PLSP has trained 127 833 bystanders with 5073 instructors in the past 2.5 years who continue to provide PLSP trainings nationwide (table 2).

### Inner context

Vast acceptance of PLSP's aim allowed the training's expansion to other sectors such as engineering, technology, etc, which used social media platforms to convey their interest. Selecting the

**Table 2** Distribution of national life-savers in Pakistan

	Life-savers n (%)
Gender (bystanders)	127833
Male	83916 (65.6)
Female	43917 (34.4)
Bystanders	127833
Punjab	118052 (92.3)
Sindh	8722 (6.8)
Khyber Pakhtunkhwa and Gilgit	593 (0.5)
Balochistan	466 (0.4)
Instructors	5073
Punjab	4841 (95.4)
Sindh	137 (2.7)
Khyber Pakhtunkhwa and Gilgit	26 (0.5)
Balochistan	69 (1.4)

submaster trainers from within their organizations/communities made the process convenient and allowed efficient learning where people were more comfortable and acceptable in learning new skills taught by one of their own.

Formative and summative evaluations aided in providing evidence of improvements in individuals' knowledge and skills regarding CPR and bleeding control. The summative assessment included a 10 multiple-choice question survey and was marked numerically before and after session to determine the change in knowledge of participants. To assess skills, each participant underwent a hands-on evaluation after session where they demonstrated CPR and bleeding control technique taught. Each participant's competency was evaluated by a master trainer for each step, where level 1 referred to 'Requiring close supervision', level 2 depicted 'May require moderate supervision' and level 3 indicated 'Requires little or no supervision'. However, the time taken to complete the presurveys and postsurveys exceeded the anticipated duration. Since hands-on practice and skills were the mainstay, knowledge component was excluded from the summative evaluation.

The training was further made conducive by introducing the concept of using an online metronome during the practice sessions. This helped the participants to achieve the optimum rate of chest compressions (100–120 beats per minute (bpm)). Growth of PLSP resulted in expansion of its structure where two more teams were included: (1) communications team; for marketing and providing an avenue for interested institutions to reach out, and (2) research team; for overseeing evaluations and determining pedagogies that could expand PLSP's goals.

#### Outer context

Discussion to incorporate PLSP into a single national educational curriculum led to the creation of a committee dedicated to modifying and integrating the content in secondary education. Specific components from the curricular content were highlighted for each grade (from Grade VI to Grade XI) such as safety and communication within the first year, bleeding control in the second year, etc, with each training session being held once annually. Furthermore, teachers at the targeted schools were enrolled to become master trainers and teach their students. Support from the leadership, ease of curriculum implementation and adequate teachers being trained ensured quality implementation of PLSP within secondary education.

Additionally, regular biannual meetings with the international and quarterly meetings with the national advisory boards deemed vital in identifying any barriers faced by the core team or trainers during the implementation of PLSP and bringing up solutions toward it. These meetings also paved a way for recommendations regarding quickening the pace of outreach and broadening collaborative opportunities. Community-based organizations further took a leading role in disseminating awareness regarding PLSP. However, arranging a constant availability of manikins was a hindrance often faced by certain partnering organizations, since the increasing number of training sessions exceeded that of manikins. Hence, further opportunities were sought to collaborate with companies providing effective, low-cost simulation models. This motivated exploration of ideas for sustainable availability of manikins.

#### Bridging and innovation factors

Discussions were conducted to make collaborations with agencies producing high-quality CPR and bleeding control simulation models, leading to its increased accessibility for partnering institutes. Furthermore, presenting PLSP at international conferences and innovation seminars gained recognition which invited large-scale partnerships.

As an alternative to cost-effective applicability of PLSP, discussions were initiated with international organizations using a virtual platform for dissemination of CPR and bleeding control skills. These included STB and other start-ups using mobile-based applications which allowed expansion of PLSP from a face-to-face training session to a web-based program.<sup>34</sup> Moreover, PLSP instructors were enrolled in a biannual advanced CPR training curriculum called 'Leadership in Resuscitation Course' to develop their resuscitation competency using high-fidelity manikins. This course was introduced in collaboration with the Resuscitation Academy, a US-based non-profit foundation aimed to increase survival after cardiac arrest globally.<sup>35</sup>

#### Phase 4: sustainment

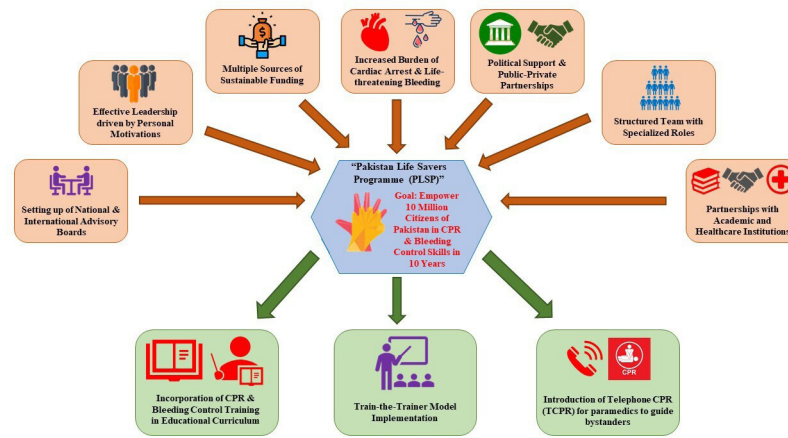
Figure 2 summarizes the sustainment strategies for PLSP to achieve its vision.

#### Inner context

Presence of PLSP within social networks and extensive marketing of this initiative using diverse avenues have allowed far-flung awareness within the country. Its action-driven work inspires external institutions to reach out and discuss ways of conducting sessions within their vicinities. A wide network of passion-driven trainers has been developed who conduct trainings in various settings. Feedback reports from the lead trainers for new recruits aid in determining their fidelity and ensuring continuous action.

Partners are encouraged to conduct training sessions within their vicinities to inculcate self-efficacy. To ascertain active participation, each partnering institution has been provided with a target of life-savers that should be achieved daily, inspiring vigorous enrollment of participants. Due to unforeseen circumstances, these numbers are often difficult to maintain but development of following strategies has helped with the outreach:

- ▶ Regular meetings with all partners to ensure a closed loop of communication.
- ▶ Allocation of specific regions to each partner to prevent overlap and gain a wider audience.
- ▶ Identification of active partners to provide encouragement and inspiration as part of the quarterly newsletters.



**Figure 2** Sustainment strategies for Pakistan Life Savers Programme (PLSP). CPR, cardiopulmonary resuscitation.

### Outer context

Along with funds from the pledge, sponsorship from research grants and the AMC's president's funds have proven to be substantial in expanding PLSP's mandate. Discussions for effective application of bystander protection law proved successful in receiving approval from provincial governments and now awaits review of the Cabinet for final acceptance.

Effective interactions with stakeholders have resulted in incorporation of PLSP's content into a single national educational curriculum, where basic CPR and bleeding control knowledge is initially shared with primary schoolchildren (Grades VI–VIII), followed by teaching of skills and practice sessions at secondary level (Grade IX and Grade X). These sessions initiate with a refresher course, followed by content delivery through presentations. Since the teaching is conducted once annually during school timings and does not require extra preparation, no financial incentives are provided. However, recognition is provided to the teachers in the form of certificates/awards for sustaining their motivation.

Another essential step taken toward sustainability of PLSP has been the introduction of telephone-assisted CPR (T-CPR) among paramedics working in a public sector ambulance service system. Since the time between an emergency call and arrival of EMS is critical, T-CPR provides an opportunity to callers to listen and deliver compressions to OHCA victims.<sup>36</sup> T-CPR curriculum established by the Resuscitation Quality Improvement Program within AHA was adapted for use in our setting.<sup>37</sup> Extensive sessions have been conducted to train them for guiding a bystander on how to provide adequate CPR through a phone.

### Bridging and innovation factors

COVID-19 pandemic affected the dissemination of PLSP's mission adversely since it prevented teaching the included skills to targeted youth. However, ongoing trainings were continued for other groups, such as employees in partnering institutions, while ensuring protective measures against COVID-19. Positive collaborative opportunities have been fostered at multiple levels of the country, and long-term partnerships have been established to ensure efficient implementation and allow healthy discussions with innovative solutions.

These opportunities have also been extended by reaching out to international organizations who have achieved a high success rate in teaching similar skills to bystanders via mobile applications. Since Pakistan is a low-resource country where citizens often lack necessities of life, such mobile applications might be

difficult to cater to the whole population. However, efforts have been made to introduce this alternative for the applicable audience using PLSP's website. For resource-constrained districts, substitutes for manikins have been explored such as pillows and self-made dummies to provide an experience as real as possible.

### DISCUSSION

This article uses the EPIS framework to describe feasible and sustainable implementation of a nationwide program in an RLS, aimed at empowering citizens in life-saving skills of CPR and bleeding control. The exploration phase identified a sustainable intervention to empower bystanders in basic life-saving skills. The preparation phase indicated steps undertaken to expand PLSP's network and invite collaborations which can provide adequate funding and resources. Implementation phase described the pilot phase of PLSP, followed by its active application to diverse areas within the country. Sustainment phase featured PLSP's integration into national curriculum and expansion of collaborative network for further outreach.

Sufficient resources have made it possible for CPR and bleeding control trainings to be conducted in HICs, which have shown encouraging results of equipping bystanders with basic life-saving skills.<sup>38–39</sup> These programs incorporated improved equipment in emergency response vehicles and introduced the use of an automated external defibrillator through a large workforce which is challenging to replicate in an RLS. Thereby, a novel approach with minimal resources, yet effective outcomes, was required which could be replicated in similar settings. Even though EPIS framework was developed to describe implementation of social service projects,<sup>25</sup> its holistic approach in describing an intervention's application made it fit to use for PLSP. This also aided in highlighting the inner context, outer context, and bridging factors from an LMIC perspective, which has rarely been done previously using the EPIS model.

The exploration phase was initiated with identifying a clinical need of bystander CPR and bleeding control through previous literature that suggested a high mortality rate due to OHCA and traumatic bleeding in Pakistan.<sup>26–27</sup> It encouraged public–private partnerships and securing political and financial support which has shown to play a pivotal role in the successful implementation of public health interventions.<sup>40–42</sup> In an RLS, it is important to identify long-term support mechanisms within the initial stages to ensure sustainability, as shown by PLSP's implementation.

Similarly, the preparation phase for PLSP enabled development of strategies which could be used to facilitate factors for



the initiative's growth and overcome barriers. Major barriers previously identified in bystander CPR and bleeding control training are differences in perceived skills and the ability to perform it, participant fees and fear of legal consequences.<sup>43</sup> Hence, our training included demonstration of skills at multiple instances of the session to ensure proper application of the learnt skill. Furthermore, it was made free of cost for all participants to allow maximum dissemination and highlighted the importance of life over legalities.

Train-the-trainer model was used for the implementation of PLSP which is considered as a valuable approach in public health preparedness and has been proven successful in previous CPR trainings for bystanders.<sup>44</sup> An important limitation experienced during this phase was a dearth of manikins which led to partnerships for portable manikins. Literature suggests use of foam dices and pillows as alternative to CPR models,<sup>45–46</sup> which was also adopted for PLSP in difficult-to-reach areas. Furthermore, understanding on how to apply a uniform compression rate between 100 and 120 bpm was simplified by using metronome as a standard of consistency.<sup>47</sup>

Since PLSP is an ongoing initiative, gauging an accurate sense of its sustainability is limited. However, introduction of its content within the national educational curriculum can be considered as a step forward in this direction. A previous study concluded 10-year-old students to perform CPR skills effectively as compared with 13-year-olds.<sup>48</sup> Similarly, incorporating STB training within formal educational curriculum has shown students to have increased comfort and confidence.<sup>49</sup> Diverse financial avenues further secured long-term sustenance of PLSP as shown by a systematic review highlighting the importance of combined community, service and system-level funding models.<sup>42</sup>

The methodology described provides a structural framework which could be replicated within other similar settings while implementing a community-based healthcare intervention. PLSP's national initiative is a novel approach which has not been reported previously from an LMIC. Furthermore, it indicates essential input, which should be used for production of a large-scale output. However, there were some limitations during the process. Pakistan is a populous country with its citizens living in diverse terrains. Hence, restricted access was available to the largest province of the country (Balochistan) with a population of around 12 million people due to difficult landscape and security concerns. Alternatives are being explored to increase PLSP's outreach to these regions. Another limitation is the absence of an accurate model to ascertain the required percentage of trained population that can bring about an appropriate change. Extrapolating statistics from Western states,<sup>50</sup> the crude target of reaching 5% population is still applicable to Pakistan and has the capacity for adaptation as time goes by.

## CONCLUSION

There is a public health imperative to strengthen prehospital care in low-resource settings. Initiatives to empower bystanders could lead to positive outcomes, especially for conditions such as cardiac arrest and life-threatening bleeding after trauma. Novel and feasible approaches should be used to encourage active role of bystanders in such situations that can reduce the burden of preventable mortality in LMICs.

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## ORCID iD

Asma Altaf Hussain Merchant <http://orcid.org/0000-0002-0393-2079>

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