







# Fifteen Years of Sustainable Development in Emergency Medical Services under the Emergency Medicine Act of Thailand

Korakot Apiratwarakul<sup>1</sup>, Somsak Tiamkao<sup>2</sup>, Vajarabhongsa Bhudhisawasdi<sup>1</sup>, Lap Woon Cheung<sup>3,4</sup>, Kamonwon Ienghong<sup>1\*</sup>

<sup>1</sup>Department of Emergency Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand; <sup>2</sup>Department of Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand; <sup>3</sup>Department of Accident and Emergency, Princess Margaret Hospital, Kowloon, Hong Kong; <sup>4</sup>Emergency Medicine Unit, Li Ka Shing Faculty of Medicine, The University of Hong Kong, Pokfulam, Hong Kong

## Abstract

**Edited by:** Sasho Stoileski  
**Citation:** Apiratwarakul K, Tiamkao S, Bhudhisawasdi V, Cheung LW, Ienghong K. Fifteen Years of Sustainable Development in Emergency Medical Services under the Emergency Medicine Act of Thailand. Open-Access Maced J Med Sci. 2022 May 18; 10(E):987-991. <https://doi.org/10.3889/oamjms.2022.9895>  
**Keywords:** Emergency medical services; Emergency health services; Pre-hospital emergency care; Sustainable development goals; Smart growth  
**\*Correspondence:** Kamonwon Ienghong, Department of Emergency Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen 40002, Thailand. E-mail: [kamonwan@kku.ac.th](mailto:kamonwan@kku.ac.th)  
**Received:** 25-Feb-2022  
**Revised:** 20-Apr-2022  
**Accepted:** 08-May-2022  
**Copyright:** © 2022 Korakot Apiratwarakul, Somsak Tiamkao, Vajarabhongsa Bhudhisawasdi, Lap Woon Cheung, Kamonwon Ienghong  
**Funding:** This research did not receive any financial support  
**Competing Interest:** The authors have declared that no competing interest exists  
**Open Access:** This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

**BACKGROUND:** Thailand's emergency medical services (EMSs) are constantly evolving both in terms of personnel and technology in pre-hospital care. While sustainable development goals (SDGs) are used in part as a catalyst for development in all countries, there are currently no studies regarding the relationship between EMS research and SDGs in Thailand.

**AIM:** This study aims to analyze how Thailand's EMS research was affected after the National Institute for Emergency Medicine (NIEM) was established and how SDGs are related.

**METHODS:** This was an analytical cross-sectional database study. Data were collected in the Scopus database with Thailand's EMS records between 2008 and 2022. Three experienced emergency physicians were enrolled independently in this study for the purpose of giving opinions and feedback on the research.

**RESULTS:** The three experts of this study are qualified emergency physicians in Thailand. The greatest number of the expert's publications from the Scopus database was 117 articles. The greatest number of citations was 3994. The 175 documents were analyzed with three experts reviewing all documents and then narrowing it down to 25 documents. The most common SDG found in documents was Goal 3: GOOD HEALTH AND WELL-BEING.

**CONCLUSIONS:** The development of Thailand's EMS after the establishment of NIEM varied in aspects ranging from triage systems and care in ambulances to vehicle selection and technology. Goal 3: GOOD HEALTH AND WELL-BEING occurred most frequently in publications regarding SDGs in EMS studies.

## Introduction

The development of Thailand's emergency medical services (EMSs) is most commonly thought of as being divided into two phases [1], [2], [3]. In the first phase, which can be considered as any time before 2008, there was still a lack of personnel management systems, equipment, and specialized tools when it came to assessing emergency patients. The lack of responsible agencies coordinating operations led directly to preventable deaths in emergency patients, the impairment of vital organs resulting in injury or illness, and worsening long-term health consequences. The second phase arrived in 2008 with the establishment of the National Institute for Emergency Medicine (NIEM) which was responsible for the management coordination between relevant agencies in both the public and private sectors and encouraged local government organizations to play a more active and standardized role in management.

By 2022, Thailand's EMS under the supervision of the NIEM entered its 15<sup>th</sup> year of development, with

services across the board all greatly improved. A variety of emergency vehicles are now organized by air, land, and sea. Artificial intelligence and modern technology assist the operations in caring for emergency patients as soon as they get in the ambulance [4], [5].

Under issue 3.1 of the National Emergency Medicine Master Plan 2019–2022, conditions under the current global trends along with future challenges were analyzed together and applied to the situation and context of Thai society, in particular, how it is related to the EMS system. It was found that the goals of the Master Plan are consistent and linked to the United Nations sustainable development goals (SDGs). It is also in line with the guidelines of the Constitution of the Kingdom of Thailand B.E. 2560 (2017), the 20-year national strategy, government policies, the Thailand 4.0 policy, and the 12<sup>th</sup> National Economic and Social Development Plan. The ultimate aim being the development of highly capable out-of-hospital EMS, emergency referral, and disaster management in medicine and public health that focuses on reducing death and disability from emergency situations and severe illnesses requiring immediate treatment.

Therefore, studies related to EMS strategies in the establishing of agencies will be of greater importance in the development and extension to their own hospitals with adjusting and changing to suit each context to continue the transfer of knowledge on the global scale. The aim of this study was to analyze how Thailand's EMS research was affected after the NIEM was established and how SDGs are related.

## Methods

### Study design and setting

This was an analytical cross-sectional database study. Data were collected from the research found in the Scopus database with related articles referencing Thailand's EMS between 2008 and 2022. The research was carried out at Khon Kaen University which is the first university founded in Northeast Thailand. It was established to advance human resources and enhance knowledge to develop the region. The university aims to create social stability through the employment and practice of the United Nations SDGs.

### Data collection

The three experienced emergency physicians (with collectively more than 50 published articles in the Scopus database) were independently enrolled in this study. Each expert reviewed the Scopus database for Thailand's EMS-related articles with regard to their practices aligning with those outlined in the SDGs strategies. The United Nation SDGs lay out 17 of these goals including:

- Goal 1: No poverty
- Goal 2: Zero hunger
- Goal 3: Good health and well-being
- Goal 4: Quality education
- Goal 5: Gender equality
- Goal 6: Clean water and sanitation
- Goal 7: Affordable and clean energy
- Goal 8: Decent work and economic growth
- Goal 9: Industry, innovation, and infrastructure
- Goal 10: Reduced inequality
- Goal 11: Sustainable cities and communities
- Goal 12: Responsible consumption and production
- Goal 13: Climate action
- Goal 14: Life below water
- Goal 15: Life on land
- Goal 16: Peace and justice strong institutions
- Goal 17: Partnerships for the goals.

Research articles were not limited to only a single SDG, and many contained more than 1 SDG. After that initial vetting, the onsite meeting was provided

to conclude that all chosen articles matched these study criteria. An outside expert was brought in to finalize a judgment in case of disagreement.

### Data analysis

The Scopus database was signed in under individual usernames through Khon Kaen University Internet Protocol (IP) address. The expert used the Search menu within Article title, Abstract, and Keywords, then searched for documents in terms of "Thailand EMS." In the document result page, the articles which were published before 2008 were excluded from the study.

### Ethical considerations

The Human Ethics Research Committee of Khon Kaen University evaluated and authorized the study (HE651042). This study was conducted in accordance with the principle of the Helsinki and Good Clinical Practice guidelines.

## Results

The three experts of this study are qualified and practicing emergency physicians in Thailand (Table 1). The greatest number of an individual expert's publications from the Scopus database was 117 articles. In addition, there were 3994 citations found for expert A.

**Table 1: Characteristic of experts (N = 3)**

Data	Publications in Scopus database	Citations in Scopus database	H-index	Judgment articles in this study
Expert A	117	3994	28	46
Expert B	51	176	11	26
Expert C	51	166	11	20

After the process of data gathering, 204 documents were enrolled in this study. The documents which were published before 2008 were excluded, this came out to 29 total. The remaining 175 documents matched the criteria of this study and were analyzed. The experts reviewed all documents and finalized 25 documents, as shown in Table 2. The most common SDG appearing in the research was Goal 3: GOOD HEALTH AND WELL-BEING.

## Discussion

The study focused on research published in Thailand's EMS database of Scopus. After collecting the results, there were 25 relevant articles which were

**Table 2: The Thailand EMS documents (N = 25)**

No.	Title	Main objective	SDGs related	Year of publication
1	Development of performance indicators in operational level for pre-hospital EMS in Thailand	Developed the performance indicators in operational level for the pre-hospital EMS	1,3	2009
2	Factors associated with successful resuscitation of out-of-hospital cardiac arrest at Rajavithi Hospital's Narenthorn Emergency Medical Service Center, Thailand	Determine factors associated with successful resuscitation of out-of-hospital cardiac arrest patients by EMS	3,17	2011
3	Disaster medicine in Thailand: A current update. Are we prepared?	Investigate the level of major incident/disasters preparedness in Thailand	3,17	2012
4	Capability of emergency medical service response teams at Khon Kaen, Thailand	Describe capability of response team provided vital care to patients of EMS case	3,8	2012
5	An emergency medical service system in Thailand: Providers' perspectives	Determine providers' perspectives on EMS in Thailand	3,4	2014
6	Emergency medical services key performance measurement in Asian cities	Implement performance monitoring using appropriate and relevant measures including key performance indicators in EMS	3,17	2015
7	Prevalence of emergency medical service utilization in patients with out-of-hospital cardiac arrest in Thailand	Ascertain the prevalence of EMS utilization in patients with OHCA transferred to Siriraj Hospital	3,10	2016
8	Telegraphic medicine systems improve medical diagnosis in pre-hospital settings: A pilot study in a tertiary care hospital	Determine the efficacy of telegraphic medicine systems in EMS during responses by advanced life support teams	3,8	2017
9	Effect of on-scene time on survival outcome in non-traumatic out-of-hospital cardiac arrest	Determine the optimal on-scene time to maximize survival in cases of non-traumatic out-of-hospital cardiac arrest	3,5	2019
10	Use of a motorlance to deliver emergency medical services; a prospective cross-sectional study	Comparison response time between motorlance and ambulance	3,11	2019
11	Factors associated with hospital arrival time in acute stroke	Investigate the factors that significantly influence hospital arrival time after acute stroke	3,10	2019
12	Factors associated with severe intracranial pathology in acute non-traumatic headache patients in the emergency department	Analyzed factor in non-traumatic severe headache	3	2020
13	Emergency medical dispatch services across Pan-Asian countries: A web-based survey	Compares the characteristics of dispatch services within the Pan-Asian Resuscitation Outcomes network	3,17	2020
14	Factors associated with transfusion of uncross-matched type-O packed red cells for acute upper gastrointestinal hemorrhage	Analyzed factor of uncross-matched type-O used	3	2020
15	Perceived barrier in accessing emergency medical services of ethnic groups in the highlands of Chiang Rai Province, Thailand	Explore the barriers of accessing emergency medical services among several ethnic groups	1,3,5,11	2020
16	Management of anaphylactic patients by emergency medical services	Evaluated anaphylaxis patients in EMS	3	2020
17	Assessment of pre-hospital management of patients transported to a Thai University Hospital	Assess the quality of pre-hospital care given to patients transported to a Thai university hospital	3,17	2020
18	Endotracheal intubation on a stationary versus moving ambulance	Compare endotracheal tube intubation in various situations	3	2020
19	Validation of the ROSC after cardiac arrest (RACA) score in Pan-Asian out-of-hospital cardiac arrest patients	Evaluate the performance of The ROSC after cardiac arrest in a Pan-Asian population	3,5,17	2020
20	The effectiveness of oxygen-powered inhalation devices in pre-hospital care	Evaluate use of oxygen-powered inhalation devices in EMS	3	2020
21	Thai geriatric emergency patients' registry in tertiary care hospitals	Study characteristics and factors that affect the need hospital admission	1,3	2020
22	The role of mechanical cardiopulmonary resuscitation devices in emergency medical services	Evaluate mechanical cardiopulmonary resuscitation devices in EMS	3,17	2020
23	Comparison of cleaning methods for ultrasound probes at an emergency department in a resource-limited country	Compare the ultrasound cleaning methods	3,4	2020
24	Presepsin levels in emergency patients with bacterial and viral infection	Compare presepsin level in emergency patients	3,8	2020
25	Epidemiological characteristics of traffic and non-traffic injuries and quality of emergency medical services in southern Thailand	Report the situation of injuries and emergency medical services in South Thailand.	1,3,8	2021

EMS: Emergency medical service, OHCA: Out-of-hospital cardiac arrest; ROSC: Return of spontaneous circulation.

found to be in accordance with the objectives of the study [6], [7], [8], [9], [10], [11], [12] [13], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30]. Most of the articles study pre-hospital operations, both in terms of personnel working, budget used, and the effects on the patients' outcomes. There are both areas of study in Thailand and the greater Association of Southeast Asian Nations (ASEAN) region.

As a result, one of the primary areas ready for development in Thailand's EMS is the novice technology that has been used to assist in caring for more patients. One of the technologies to be discussed is the use of portable ultrasound machines [28]. The device is small and can be carried on ambulances. As a result, EMS members can diagnose symptoms more quickly and accurately from the ambulance. However, the previous studies have found that cleaning the tool with water was insufficient for disinfection [28]. Therefore, it must rely on specific detergents obtained from studies for effective cleaning and reducing contamination from one

patient to another, especially in the epidemic situation of coronavirus.

Another innovation that has been used in pre-hospital care is the use of motorcycles to be converted into emergency ambulances for the benefit of quick access to patients in large cities where traffic is congested [15]. The application of such vehicles is a sustainable solution to meet the expansion of cities and more vehicles on the road.

Medical telemedicine has played an important role in caring for patients on ambulances from the time that information was transmitted only by voice over the phone or by radio. The introduction of telemedicine technology allows physicians stationed in the emergency room to take a history, preliminary physical examination, and prescribe treatment to patients from the ambulance resulting in time sensitive conditions which can be life saving for pre-hospital patients [13], [15], [16].

In addition, SDGs can be considered an important new paradigm for the world. Thailand's

EMS has taken active steps to achieve these goals that must be shared collectively throughout the world by all nations if we are to be successful. The authors would recommend Thailand to initially take a three-step approach. First, Thailand EMS will create technology to gain better access both to and from people with disabilities and the elderly. Second, the use of artificial intelligence to assess emergency patients for appropriate and time sensitive operations must be improved. The last is to encourage a broader transfer of knowledge to develop EMS practices to all ASEAN member countries.

The study has some limitations including: 1) This judgment of agreement in this study was provided by only three experts and 2) the data from this study were only provided by a Scopus database which may not cover all areas of published articles.

## Conclusions

The development of Thailand's EMS after the establishment of NIEM varied in aspects ranging from triage systems and care in ambulances to vehicle selection and technology. Goal 3: GOOD HEALTH AND WELL-BEING occurred most frequently in publications regarding SDGs in EMS studies.

## Acknowledgment

The authors would like to express their sincere gratitude to Josh Macknick for acting as an English consultant.

## References

- Pochaisan O, Pattanarattanamolee R, Pongphuttha W, Chadbunchachai W, Nakahara S. Development of an emergency medical services system in Thailand: Roles of the universal health coverage and the national lead agency. *Emerg Med Australas*. 2021;33(4):756-8. <https://doi.org/10.1111/1742-6723.13794>  
PMid:33977648
- Huabbangyang T, Klaiaungthong R, Jansanga D, Aintharasongkho A, Hanlakorn T, Sakcharoen R, *et al*. Survival rates and factors related to the survival of traffic accident patients transported by emergency medical services. *Open Access Emerg Med*. 2021;13:575-86. <https://doi.org/10.2147/OAEM.S344705>  
PMid:34955659
- Pattanarattanamolee R, Sanglun RY, Nakahara S. Community-based first responder network in rural Thailand: A case study of out-of-hospital cardiac arrest. *Prehosp Disaster Med*. 2021;36(2):234-6. <https://doi.org/10.1017/S1049023X20001545>  
PMid:33599577
- Kandimalla J, Vellipuram AR, Rodriguez G, Maud A, Cruz-Flores S, Khatri R. Role of telemedicine in prehospital stroke care. *Curr Cardiol Rep*. 2021;23(6):71. <https://doi.org/10.1007/s11886-021-01473-8>  
PMid:33970356
- Wang Q, He Y, Hajat S, Cheng J, Xu Z, Hu W, *et al*. Temperature-sensitive morbidity indicator: Consequence from the increased ambulance dispatches associated with heat and cold exposure. *Int J Biometeorol*. 2021;65(11):1871-80. <https://doi.org/10.1007/s00484-021-02143-8>  
PMid:33963898
- Memongkol N, Sinthavalai R, Seneeratanaprayune N, Ounsaneha W, Choosuk C. Development of performance indicators in operational level for pre-hospital EMS in Thailand. *World Acad Sci Eng Technol*. 2009;3(10):1889-94.
- Yeeheng U. Factors associated with successful resuscitation of out-of-hospital cardiac arrest at Rajavithi Hospital's Narenthorn Emergency Medical Service Center, Thailand. *Asia Pac J Public Health*. 2011;23(4):601-7. <https://doi.org/10.1177/1010539511411902>  
PMid:21727081
- Angthong C, Kumjornkijjakarn P, Pangma A, Khorram-Manesh A. Disaster medicine in Thailand: A current update. Are we prepared? *J Med Assoc Thai*. 2012;95 Suppl 1:S42-50.  
PMid:23964443
- Kruesathit O, Laopaiboon M, Chadbunchachai W. Capability of emergency medical service response teams at Khon Kaen, Thailand. *Res J Med Sci*. 2012;6(5):232-7. <https://doi.org/10.3923/rjmsci.2012.232.237>
- Sittichanbuncha Y, Prachanukool T, Sarathep P, Sawanyawisuth K. An emergency medical service system in Thailand: Providers' perspectives. *J Med Assoc Thai*. 2014;97(10):1016-21.  
PMid:25632616
- Rahman NH, Tanaka H, Shin SD, Ng YY, Piyasuwankul T, Lin CH, *et al*. Emergency medical services key performance measurement in Asian cities. *Int J Emerg Med*. 2015;8:12. <https://doi.org/10.1186/s12245-015-0062-7>  
PMid:25932052
- Monsomboon A, Chantawatsharokorn P, Saksuriyayothin S, Keorochana K, Mukda A, Prapruetkit N, *et al*. Prevalence of emergency medical service utilisation in patients with out-of-hospital cardiac arrest in Thailand. *Emerg Med J*. 2016;33(3):213-7. <https://doi.org/10.1136/emered-2015-204818>  
PMid:26531862
- Chinprasatsak S, Sathapong S, Kotruchin P, Maporn K. Telegraphic medicine systems improve medical diagnosis in pre-hospital settings: A pilot study in a tertiary care hospital. *J Med Assoc Thai*. 2017;100(6):686-91.
- Buranasakda M, Pattanarattanamolee R, Lenghong K, Rattanaseeha W, Kotruchin P. Effect of on-scene time on survival outcome in non-traumatic out-of-hospital cardiac arrest. *J Med Assoc Thai*. 2019;102(5):606-10.
- Apiratwarakul K, Lenghong K, Mitsunghern T, Kotruchin P, Phungoen P, Bhudhisawasdi V. Use of a Motorlance to Deliver Emergency Medical Services; A prospective cross sectional study. *Arch Acad Emerg Med*. 2019;7(1):e48.  
PMid:31602431
- Wannarong T, Chotik-Anuchit S, Nilanont Y. Factors associated with hospital arrival time in acute stroke. *J Med Assoc Thai*. 2019;102(5):547-53.
- lenghong K, Ussahgij W, Kanthachat K, Apiratwarakul K, Phungoen P, Bhudhisawasdi V. Factors Associated with Severe



- Intracranial Pathology in Acute Non-Traumatic Headache Patients in the Emergency Department. *J Med Assoc Thai.* 2020;103 Suppl 6:47-50.
18. Lee SC, Mao DR, Ng YY, Leong BS, Supasaovapak J, Gaerlan FJ, *et al.* Emergency medical dispatch services across Pan-Asian countries: A web-based survey. *BMC Emerg Med.* 2020;20:1. <https://doi.org/10.1186/s12873-019-0299-1> PMID:31910801
  19. Ienghong K, Srikumpa P, Apiratwarakul K, Phungoen P, Gaysonsiri D, Bhudhisawasdi V. Factors Associated with Transfusion of Uncross-matched Type-O Packed Red Cells for Acute Upper Gastrointestinal Hemorrhage. *J Med Assoc Thai.* 2020;103 Suppl 6:22-6.
  20. Sungbun S, Tangkawanich T, Thanakumma O, Sukrueangkul A. Perceived barrier in accessing emergency medical services of ethnic groups in the highlands of Chiang Rai Province, Thailand. *J Health Sci Med Res.* 2020;38(2):125-33. <https://doi.org/10.31584/jhsmr.2020731>
  21. Apiratwarakul K, Mitsungnern T, Thatphet P, Ienghong K, Ruttanaseeha W, Bhudhisawasdi V. Management of anaphylactic patients by emergency medical services. *J Med Assoc Thai.* 2020;103 Suppl 6:11-4.
  22. Riyapan S, Chantanakomes J, Ruangsomboon O, Chaisirin W, Limsuwat C, Prapruetkit N, *et al.* Assessment of prehospital management of patients transported to a Thai University Hospital. *Siriraj Med J.* 2020;72(4):287-95. <https://doi.org/10.33192/Smj.2020.39>
  23. Apiratwarakul K, Pumiyoch P, Ienghong K, Phungoen P, Gaysonsiri D, Bhudhisawasdi V. Endotracheal Intubation on a Stationary vs Moving Ambulance. *J Med Assoc Thai.* 2020;103 Suppl 6:18-21.
  24. Liu N, Ong ME, Ho AF, Pek PP, Lu TC, Khruengkarnchana P, *et al.* Validation of the ROSC after cardiac arrest (RACA) score in Pan-Asian out-of-hospital cardiac arrest patients. *Resuscitation.* 2020;149:53-9. <https://doi.org/10.1016/j.resuscitation.2020.01.029> PMID:32035177
  25. Apiratwarakul K, Ienghong K, Gaysonsiri D, Mitsungnern T, Buranasakda M, Bhudhisawasdi V. The effectiveness of oxygen-powered inhalation devices in prehospital care. *J Med Assoc Thai.* 2020;103 Suppl 6:58-60.
  26. Maneekun W, Thatphet P, Kotruchin P, Tantibundit P. Thai geriatric emergency patients' registry in tertiary care hospitals. *J Med Assoc Thai.* 2020;103 Suppl 6:78-83.
  27. Apiratwarakul K, Songserm W, Ienghong K, Phungoen P, Gaysonsiri D, Bhudhisawasdi V. The role of mechanical cardiopulmonary resuscitation devices in emergency medical services. *J Med Assoc Thai.* 2020;103 Suppl 6:98-101.
  28. Ienghong K, Kleebuakwan K, Apiratwarakul K, Phungoen P, Gaysonsiri D, Bhudhisawasdi V. Comparison of cleaning methods for ultrasound probes at an emergency department in a resource-limited country. *J Med Assoc Thai.* 2020;103 Suppl 6:67-71.
  29. Apiratwarakul K, Srimookda N, Phungoen P, Ienghong K, Tiamkao S, Bhudhisawasdi V. Presepsin levels in emergency patients with bacterial and viral infection. *Open Access Maced J Med Sci.* 2020;8(A):20-3. <https://doi.org/10.3889/oamjms.2020.3204>
  30. Prommoon P, Phibalsak T, Netwachirakul J, Mekthat M, Jitpiboon W, Sangthong R. Epidemiological characteristics of traffic and non-traffic injuries and quality of emergency medical services in Southern Thailand. *J Health Sci Med Res.* 2021;39(4):273-82. <https://doi.org/10.31584/jhsmr.2021783>