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

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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 15th 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 12th 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 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>
<thead>
<tr>
<th>Data</th>
<th>Publications in Scopus database</th>
<th>Citations in Scopus database</th>
<th>H-index</th>
<th>Judgment articles in this study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert A</td>
<td>117</td>
<td>3994</td>
<td>28</td>
<td>46</td>
</tr>
<tr>
<td>Expert B</td>
<td>51</td>
<td>176</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td>Expert C</td>
<td>51</td>
<td>166</td>
<td>11</td>
<td>20</td>
</tr>
</tbody>
</table>

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
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

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

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

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

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